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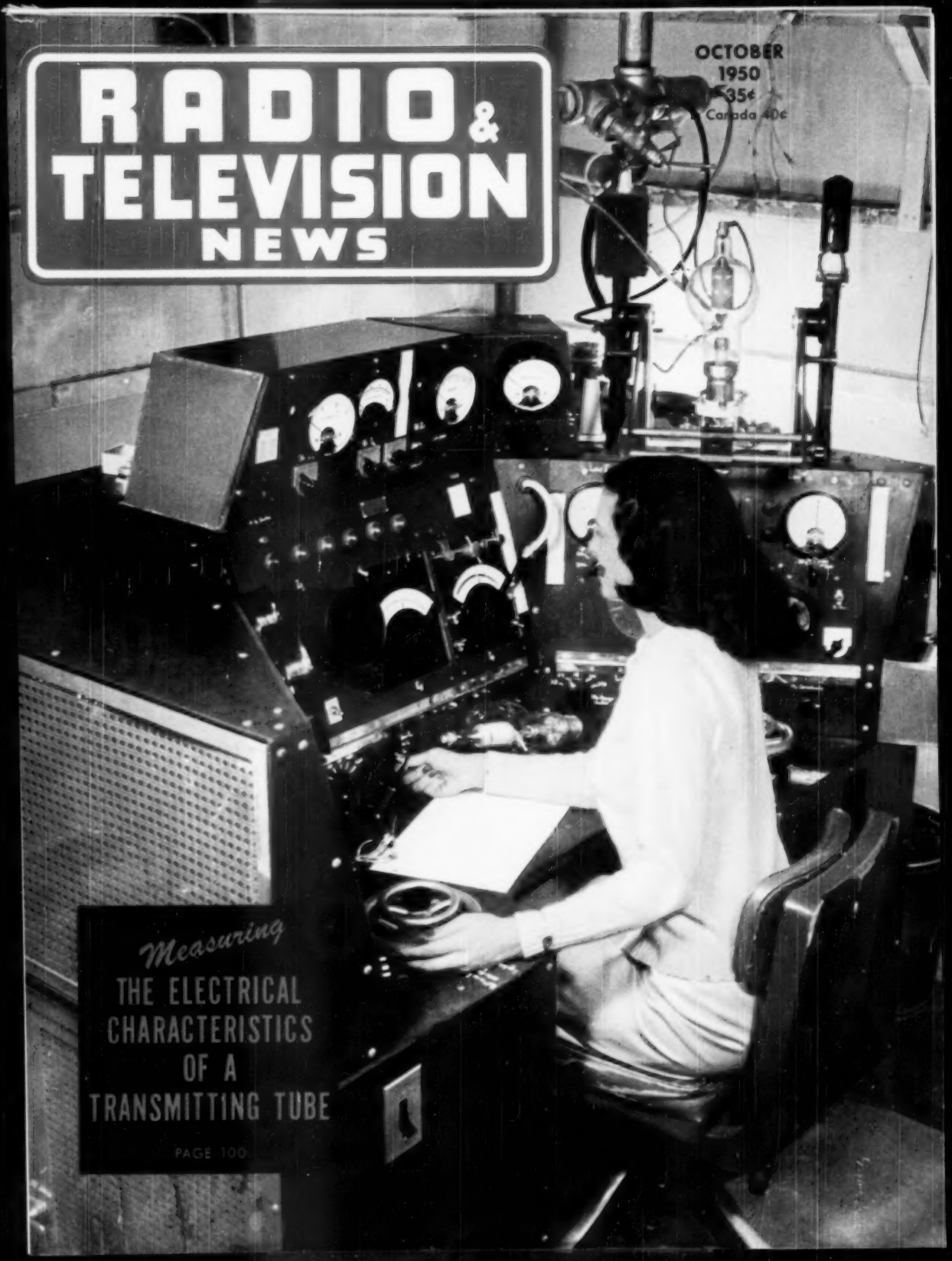
RADIO & TELEVISION NEWS



Measuring
THE ELECTRICAL CHARACTERISTICS OF A TRANSMITTING TUBE

PAGE 100

You Practice COMMUNICATIONS

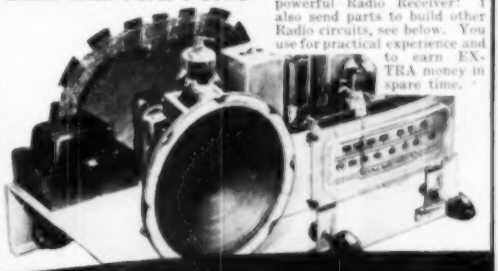
I Send You Parts To Build This Transmitter

As part of my Communications Course you build this low power broadcasting transmitter, learn how to put a station "on the air," perform procedures demanded of Broadcast Station operators, make many tests.

You Practice Radio SERVICING

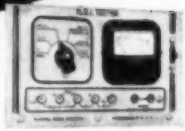
On This Modern Radio You Build With Parts I Send

As part of my Servicing Course, I send you the speaker, tubes, chassis, transformer, loop antenna, EVERYTHING you need to build this modern, powerful Radio Receiver! I also send parts to build other Radio circuits, see below. You use for practical experience and to earn EXTRA money in spare time.



BE A RADIO-TELEVISION TECHNICIAN

YOU BUILD this Tester with parts I send early in my Servicing Course. Helps you fix neighbors' Radios and EARN EXTRA MONEY in spare time.



YOU BUILD Vacuum Tube Power Pack as part of my Communications Course; get experience with packs of many kinds. Learn how to correct Power Pack troubles.

YOU BUILD this A. M. Signal Generator as part of my Servicing Course. It provides amplitude - modulated signals for many tests and experiments.

Learn Servicing or Communications by Practicing in Spare Time with KITS OF RADIO PARTS I Send

J. E. SMITH, President National Radio Institute

Do you want good pay, a job with a bright future and security? Would you like to have a profitable shop or store of your own? If so, find out how you can realize your ambition in the fast growing, prosperous RADIO-TELEVISION industry. Even without Television, the industry is bigger than ever before. 81 million home and auto Radios, 2,700 Broadcasting Stations, expanding use of Aviation and Police Radio, Micro-wave Relay, Two-way Radio for buses, taxis, etc., are making opportunities for Servicing and Communications Technicians and FCC-Licensed Operators.

Television is TODAY'S Good Job Maker

In 1949, almost 3,000,000 TV sets sold. By 1954, 20,000,000 TV sets estimated. 108 TV Stations now operating. Authorities predict 1,000 TV Stations. This means more jobs, good pay for qualified men all over the United States and Canada.

Many Soon Make $10 Extra a Week in Spare Time

Keep your job while training. Hundreds of successful RADIO-TELEVISION TECHNICIANS I trained had no previous experience, some only a grammar school education. Learn Radio-Television principles from illustrated lessons. Get PRACTICAL EXPERIENCE—build valuable multitester—experiment with circuits common to Radio and Television. Keep all equipment. Many students make $5, $10 extra a week fixing neighbors' Radios in spare time. SPECIAL BOOKLETS start teaching you the day you enroll.

Send Now For 2 Books FREE—Mail Coupon

Send now for my FREE DOUBLE OFFER. You get actual Servicing lesson to show you how you learn at home. Also my 64-page book, "How to Be a Success in Radio-Television." Read what my graduates are doing, earning; see equipment you practice with at home. Send coupon in envelope or paste on postal. J. E. SMITH, President, Dept. OKR, National Radio Institute, Washington 9, D. C. Our 37th Year.

I TRAINED THESE MEN

"I have been operating my own Servicing business. In two years I did $14,000 worth of business; net profit, $6,850. Have one full time employee. **an** N.R.I. Student."—PHILLIP G. BROGAN, Louisville S. Ky.

"Four years ago, I was a bookkeeper with a hand-to-mouth salary. Now I am a Radio Engineer with a key station of the American Broadcasting Company network."—NORMAN H. WARD, Ridgefield Park, N. J.

"When halfway thru the N.R.I. course, I made $5 to $8 a week fixing sets in my spare time. Am now selling and installing Television sets and antennae."—E. J. STREITENBERGER, New Boston, Ohio.

"My first job was operator with KDLR obtained for me by your Graduate Service Dept. I am now Chief Engineer of Police Radio Station WQOX. I never hesitate to endorse N.R.I."—T. S. NORTON, Hamilton, O.

Veterans YOU MUST ACT FAST

G. I. Bill gives you valuable training benefits. For each 3 months of training eligibility, you can get a full year of N.R.I. Training. Keep your job while learning. But Act Now! Time is running out!

HURRY!

Mail Coupon Now!

Good for Both—FREE

MR. J. E. SMITH, President, Dept. OKR
National Radio Institute, Washington 9, D. C.

Mail me Sample Lesson and 64-page Book about How to Win Success in Radio-Television. Both FREE. (No Salesman will call. Please write plainly.)

Name ..... Age .....

Address .....

City ..... Zone ..... State .....

☐ Check if Veteran **Approved for training under G. I. Bill**

COVER PHOTO: Marjorie S. Reynolds at the test console designed by engineers of Eitel-McCullough, Inc. for checking tube performance under simulated field operating conditions.

(Ektachrome by Bryant C. Rogers)

First in radio-television-electronics

Average Paid Circulation over 200,000

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DEPARTMENTS

VOLUME 44 • NUMBER 4

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A Nice Home

A New Car

Greater Security

Happy Vacations and Travel

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I can train you to pass your FCC License Exam in a few short weeks if you've had any practical radio experience—amateur, Army, Navy, radio servicing or other. My time-proven plan can help put you, too, on the road to success.

Let me send you FREE the entire story. Just fill out the coupon and mail it. I will send you, free of charge, a copy of "How to Pass FCC License Exams," plus a sample FCC-type Exam, and the amazing new booklet, "Money Making FCC License Information."

Edw. H. Guilford
Vice President

in a Minimum of Time

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TELLS HOW— WE GUARANTEE

TO TRAIN AND COACH YOU AT HOME IN SPARE TIME UNTIL YOU GET

YOUR FCC LICENSE

TELLS HOW— Employers Make

JOB OFFERS Like These to Our Graduates Every Month

Telegram, April 7, 1950 from Chief Engineer, Broadcast Station, Pa.: "Immediate opening for engineer. Automobile and First Phone a 'must.' If graduate available please forward name and address."

Letter, April 14, 1950 from Chief Engineer, Broadcast Station, Montana: "Immediate opening for Engineer-Announcer, basic salary $62.50 . . . real future for right man."

Letter, January 30, 1950 from Chief Engineer, Broadcast Station, Tenn.: "Have openings for operators. If you have men, please have them contact us."

These are just a few examples of the job offers that come to our office periodically. Some licensed radioman filled each of these jobs . . . it might have been you!

HERE'S PROOF FCC LICENSES ARE OFTEN SECURED IN A FEW HOURS OF STUDY WITH OUR Coaching AT HOME in Spare Time

Name and Address	License	Hrs. of Training
James A. Grain [illegible]	1st Class telephone	34
Edmund R. Madson [illegible]	1st Class telephone	71
Howard J. Kirchmeyer [illegible]	2nd Class telephone	49
Ralph C. Nichols [illegible]	2nd Class telephone	34

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
Desk RN-22, 4900 Euclid Bldg., Cleveland 3, Ohio
(Approved for Veteran Training Under "GI Bill of Rights")

TELLS HOW— Our Amazingly Effective JOB-FINDING SERVICE Helps CIRE Students Get Better Jobs

Here is just one recent example of Job-Finding Results

GETS JOB WITH CAA

"I have had a half dozen or so offers since I mailed some fifty of the two hundred employment applications your school forwarded me. I accepted a position with the Civil Aeronautics Administration as a Maintenance Technician. Thank you very much for the fine cooperation and help your organization has given me in finding a job in the radio field."

Dale E. Young, 122 Robbins St., Owosso, Mich.

Your FCC Ticket is always recognized in all radio fields as proof of your technical ability.

OURS IS THE ONLY HOME STUDY COURSE WHICH SUPPLIES FCC-TYPE EXAMINATIONS WITH ALL LESSONS AND FINAL TESTS.

Get All 3 FREE

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Cleveland Institute of Radio Electronics
Desk RN-22—4900 Euclid Bldg., Cleveland 3, Ohio
(Address to Desk No. to avoid delay)

I want to know how I can get my FCC ticket in a few short weeks. Send me your FREE booklet, "How to Pass FCC License Examinations," shows me what it takes to get my license, tells me about your Job-Finding Service, as well as a sample FCC-type exam, and the amazing new booklet, "Money-Making FCC License Information."

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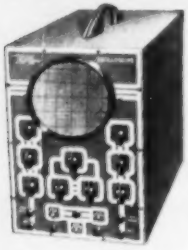
Over 50,000 SERVICEMEN must be right!

give you Laboratory Precision *at Lowest Cost!*



NEW 5" PUSH-PULL OSCILLOSCOPE

All-new laboratory-precision scope with all the extra sensitivity and response for precise servicing of TV, FM & AM sets. Push-pull undistorted vertical and horizontal amplifiers. Boosted sensitivity, .05 to .1 rms volts/inch. Useful to 2.5 MC. TV-type multivibrator sweep circuits, 15 cps—75 KC. Z-axis intensity modulation feature. Dual positioning controls move trace anywhere on screen. Complete with 2-6J5, 3-6SN7, 2-5Y3, 5BP1 CRT. 3-color etched rubproof panel; steel case. 115 v., 60 cycle AC. 8½ x 17 x 13".

Model 425-K, KIT, only $39.95

Model 425, factory wired, $69.95

NEW VACUUM TUBE VOLTMETER

Laboratory-precision VTVM for trigger-fast operation and lifetime service. 15 different ranges. Large 4½" meter, can't-burn-out circuit. New zero center for TV & FM discriminator alignment. Electronic AC & DC ranges: 0-5, 10, 100, 500, 1000 v. -30,000 volts & 200 MC with HVP-1 & P-75 probes. Ohmmeter ranges, .2 ohms to 1000 megs. DB scale. New stable double-triode balanced bridge circuit—extreme accuracy. 26 megs DC input impedance. 3-color etched rubproof panel; steel case. 115 v., 60 cycle AC. 9-7/16 x 6 x 5".

Model 221-K, KIT, only $23.95

Model 221, factory wired, $49.95

NEW TUBE TESTER

Brand new professional tube tester and merchandiser EICO Service-Engineered for unbeatable value! Large 4½" full-vision meter. Tests **conventional and TV tubes** including 9-pin miniatures. New lever-action switches—tests **every** tube element. Illuminated "Speed Roll-Chart." 2 grid caps. Short and open-element tests. Spare socket for new tubes. Protective overload bulb. Electronic rectifier. 3-color etched panel; rugged steel case. 115 v., 60 cycle AC. 12½ x 9½ x 4¾".

Model 625-K, KIT, only $29.95

Model 625, factory wired, $44.95

NEW SIGNAL GENERATOR

For FM-AM precision alignment and TV marker frequencies. Vernier Tuning Condenser. Highly stable RF oscillator, range: 150 KC—102 MC with fundamentals to 34 MC. Separate audio oscillator supplies 400-cycle pure sine wave voltage. Pure RF, modulated RF or pure AF for external testing. Attractive three-color etched rub-proof panel, rugged hammertone steel case. 115 v., 60 cycle AC. 10 x 8 x 4¾".

Model 320-K, KIT, only $19.95

Model 320, factory wired, $29.95

NEW BATTERY ELIMINATOR, CHARGER & BOOSTER

for all auto radio testing. Latest-type full-wave bridge circuit, 4-stack manganese copper-oxide rectifiers. Specially designed transformer, variable from 0 to 15 volts. Continuous: 3-8 v., 10 amps. Intermittent: 20 amps. 10,000 mfd filter condenser. Meter measures current and voltage output. Fused primary; automatic reset overload device for secondary. Hammertone steel case. 115 v., 60 cycle AC. 10½ x 7¾ x 6¾".

Model 1040-K, KIT, only $22.95

Model 1040, factory wired, $39.95

NEW DELUXE SIGNAL GENERATOR

A laboratory-precision generator EICO Service-Engineered with 1% accuracy. Extremely stable, frequency 75 KC—150 MC in 7 calibrated ranges. Illuminated hairline vernier tuning. VR stabilized line supply. 400-cycle pure sine wave with less than 5% distortion. Tube complement: 6X5, 717, 6C4, VR-150. 3-color etched panel; rugged steel case. 115 v., 60 cycle AC. 12 x 13 x 7".

Model 315-K, KIT, only $39.95

Model 315, factory wired, $59.95

NEW SWEEP GENERATOR

Covers all TV-FM alignment frequencies. 300 KC—228 MC. Vernier-driven dial; center of each of 12 TV channels marked on front panel. Sweep-width variable 0-30 MC with mechanical inductive sweep—permits gain comparison of adjacent RF TV channels. Crystal marker oscillator; variable amplitude. Provides for injection of external marker. Phasing control. Complete with RF tubes 6AS5GT, 12AU7 (dual-triode), 2-6C4. Less crystal. 10 x 8 x 6¼". 5 MC Crystal, ea. $2.95.

Model 360-K, KIT, only $29.95

Model 360, factory wired, $39.95

VOLT-OHM-MILLIAMMETER

Pocket-size VOM jam-packed with value! 22 different ranges. 3" D'Arsonval movement. Ring-type shunts. Germanium crystal rectifier. Ranges: DC: 0-5, 50, 250, 500, 2500 v. AC & Output: 0-10, 100, 500, 1000 v. DC Mir: 0-1, 10, 100. DC Amp: 0-1, 10. Ohm: 0-500, 100,000. 0-1 Meg. DB: -8 to +55. 3-color etched panel; rugged hardwood case. 8 x 4½ x 3".

Model 511-K, KIT, only $14.95

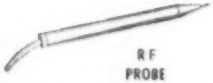
Model 511, factory wired, $17.95

MULTI-SIGNAL TRACER

Highest gain and flexibility in low-cost field. Audibly traces all IF, RF, Video and Audio from ANT to SPKR or CRT without switching. Response well over 200 MC. Integral test speaker. Provision for visual tracing with VTVM. Complete with 6S17, 6AL, 6J5. Germanium crystal diode. 3-color etched panel; rugged steel case. 115 v., 60 cycle AC. 10 x 8 x 4½".

Model 145-K, KIT, only $18.95

Model 145, factory wired, $28.95



RF PROBE

Sensitive Germanium crystal probe for signal tracing and measurements to over 200 MC. Extends range of VTVMs and scopes.

P-75K KIT, for VTVM,
P-70K for Scope, ea. $3.75

P-75 or P-76, factory wired, ea. $7.50

HIGH VOLTAGE PROBE

New professional EICO-engineered HV probe carefully designed and insulated for extra safety and versatility. Extends range of VTVMs and voltmeters up to 30,000 +. Sturdy head. Large finger guards. Multi-layer processed handle. Complete with interchangeable ceramic Multiplier to match your instrument.

HVP-1 (wired) only $6.95

EICO SUPER-SIMPLIFIED INSTRUCTIONS

Easy-to-follow step-by-step EICO pictorial and schematic instructions—most explicit and comprehensive in electronics!—supplied with each Kit. Anyone can build the EICO Kits!

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For the RECORD

BY THE EDITOR

EACH year at this time we find ourselves attending various conventions and conferences within our industry. The month of October has always been a month of planning. Engineers are attending the many technical conferences now held annually throughout the country. Radio amateurs are busy at work modifying their equipment for a long winter season of QSO'ing. The radio-TV service technician is analyzing his requirements for equipment and is studying up on requirements for a better understanding of his field of endeavor, and the audio man is planning, if possible, to attend the Audio Fair in New York the latter part of this month.

We have recognized that most of our regular readers have a keen interest in audio. That which we choose to call electronics embraces many facets within our industry. Audio, as a topic, is something we all encounter either professionally or hobby-wise as we pursue the art known as electronics. The interest in the reproduction and recording of sound has reached the point where it receives attention from nearly every radio or TV technician, student, or experimenter.

Recognizing the need for more and more practical information on audio subjects we are again devoting a major portion of our November issue to a discussion of subjects within the audio category.

We have assigned special articles to many of the leading audio men in the country. We are proud of our authors and, as usual, they have really come through with some outstanding material.

For example, Glen Southworth undertook a construction article on a high quality amplifier providing 20 watts output, dual high gain input channels, and simplified tone control. Then, there's J. N. A. Hawkins who for a period of years has been developing a novel phase inverter circuit feeding push-pull 6V6's to give 10 watts output at very low distortion. It contains a very effective tone control circuit.

Audio technicians will particularly like the article on "Sine and Square Wave Testing of A.F. Amplifiers" written by Howard Anthony, and the professional audio man, particularly one engaged in custom installations, will learn much from the article on "A High-Quality Sound System for the Home" by H. F. Olson and A. R. Morgan of *RCA Laboratories*, both prominent audio engineers.

Another one of our popular writers, J. Carlisle Hoadley, has prepared an excellent constructional article on a combined preamp and tone control unit which is compensated for Fletcher-Munson curves, and there's a very fine article of special interest to public address specialists; namely, the complete design and application of a mobile public address and auxiliary power unit which is a real money-maker.

One of the outstanding audio engineers in the country, Dr. Howard Tremaine of the *University of Hollywood*, is preparing a discussion of transmission lines for audio circuits. He will also, in the future, discuss other audio topics based on the results of years of study in the field.

Your editor will start a new series on "Complete Record-Reproduce Systems" designed for maximum utility and flexibility. The use of jack fields and other broadcast and recording studio techniques will be thoroughly discussed, and the series will analyze the advantages and disadvantages of certain audio equipment for semi-professional use.

Another well-known writer for RADIO & TELEVISION NEWS, John Goodell, discusses phonograph pickups with particular emphasis on crystal and magnetic types. Mr. Goodell also covers requirements for pickups for all three record speeds and describes some of the new "universal" stylii recently developed.

A "must" item is the article on a new simplified volume compressor designed by Edwin C. Miller of *Northwest Radio Consultant Services* and Tad Jones of Station KAVR. This article will meet with wide approval from many of our audio readers. The performance of the unit is excellent with very low distortion.

Those of you who built the tape recorder mechanism designed by Lloyd Hust will welcome the article on the design of a companion two-channel magnetic amplifier. It's easy to build and produces good results.

For those who build their own test equipment an article on a new *RC* beat frequency oscillator will certainly have wide appeal. This one is written by Richard Dorf, prominent audio consultant.

To those of us who have at one time or another encountered the hum problem there is a welcome solution to be found in the article by Lawrence Fleming showing how hum sources may be controlled. Many other articles on audio, together with regular features, will make our November issue of particular value to our readers. We think you will agree. . . O.R.

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all recommend the

Simpson Model 480 Genescope for TV-FM Servicing

Max Schinke—ADMIRAL Frank Smolek—ZENITH Ed Croxen—HALLICRAFTERS Tim Alexander—MOTOROLA

• These four well known general service managers prefer the Simpson Model 480 Genescope for their FM and TV servicing.

For proper testing, servicing, and alignment of all TV and FM receivers, the Simpson Model 480 Genescope is the ideal instrument, leading general service managers agree.

These service managers know that modern FM and TV development and servicing demands test equipment made to the most exacting standards. They prefer the Simpson Model 480 Genescope because it is the most accurate, flexible, and convenient instrument available.

The Genescope is ruggedly built to give many years of trouble-free, accurate service.

In addition to providing all necessary signal sources, the new Simpson Genescope includes a high sensitivity oscilloscope of unique advanced design, complete in every detail. Equipped with a high frequency crystal probe for signal tracing. AM and FM oscillator sections provided with large, easy to read dials with 20:1 vernier control and 1000 division logging scales. *Revolutionary, ingenious, exclusive* output termination provides for various receiver impedances, either direct or through an isolating condenser. Step attenuator for control of output. Size 22" x 14" x 7½". Weight 45 lbs. Shipping Weight 54 lbs.

DEALER'S NET PRICE complete with Test Leads and Operator's Manual $375.00

THESE RANGES SHOW HOW MUCH THE SIMPSON GENESCOPE CAN DO FOR YOU

FREQUENCY MODULATED OSCILLATOR

- Band A: 2-120 megacycles
- Band B: 140-260 megacycles
- Sweep width variable from zero to 15 megacycles
- Sweep rate 60 cycles per second
- Specially designed frequency sweep motor
- Continuously variable attenuator
- Crystal calibrator: 5 megacycles ± .05%
- Audio Oscillator 400 cycles
- Output Impedance 75 ohms
- Step attenuator for control of output

AMPLITUDE MODULATED OSCILLATOR

- Band A: 3.3-15.6 megacycles
- Band B: 15-75 megacycles
- Band C: 75-250 megacycles
- 30% modulation at 400 cycles or unmodulated
- Continuously variable attenuator
- Visual method of beat frequency indication

OSCILLOSCOPE

- Vertical sensitivity: 35 mv per inch
- Horizontal sensitivity: 70 mv per inch
- Linear sweep frequency: 3 cycles to 60 kilocycles
- 60 cycle sine sweep
- Frequency essentially flat to 200 KC. usable to over 3 megacycles

THE SIMPSON MODEL 479 TV-FM SIGNAL GENERATOR

Exactly the same circuits, ranges and functions as the Model 480, described above, with the exception of the oscilloscope. Size 17"x14"x7½", Weight 34 lbs. Shipping Weight 40 lbs.

DEALER'S NET PRICE *with Test Leads and Operator's Manual . . .* **$245.00**

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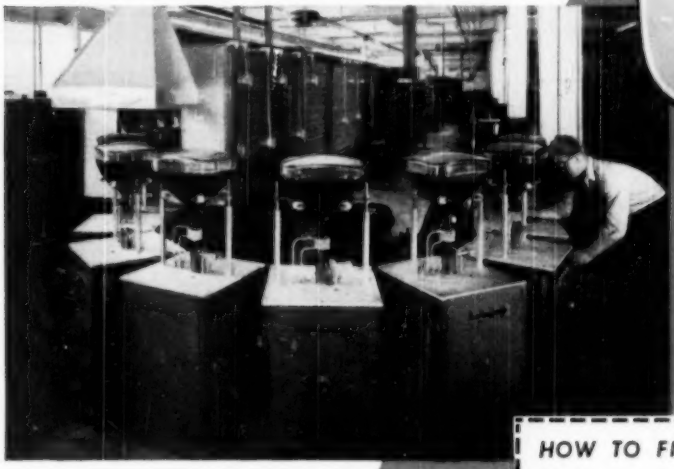
Its rectangular design really clicked. Because it is logical . . . compact . . . economical. Everyone seems to want Hytron rectangular TV picture tubes. We just haven't been able to make enough.

But now we can serve you better. With a new, ultra-modern plant devoted to rectangulars. The original Hytron 16RP4. Also the new Hytron 14-, 17-, and 20-inch tubes.

It's smart to pick Hytron rectangulars. Nine out of ten leading TV set makers do. Take advantage yourself of Hytron's leadership . . . its wide line . . . its stepped-up production. Ask for the original and best in rectangulars. Demand Hytron.



NEW PLANT
Hytron's big new TV-tube plant at Newburyport, Mass., uses latest of fast, automatic, precisely-controlled equipment to give you more tubes . . . better tubes.

New HYTRON TUBE PULLER
Makes pulling 7-pin miniatures a cinch. New, seventh Hytron shop tool now available at Hytron jobbers. Order yours today! Only 75¢ net.

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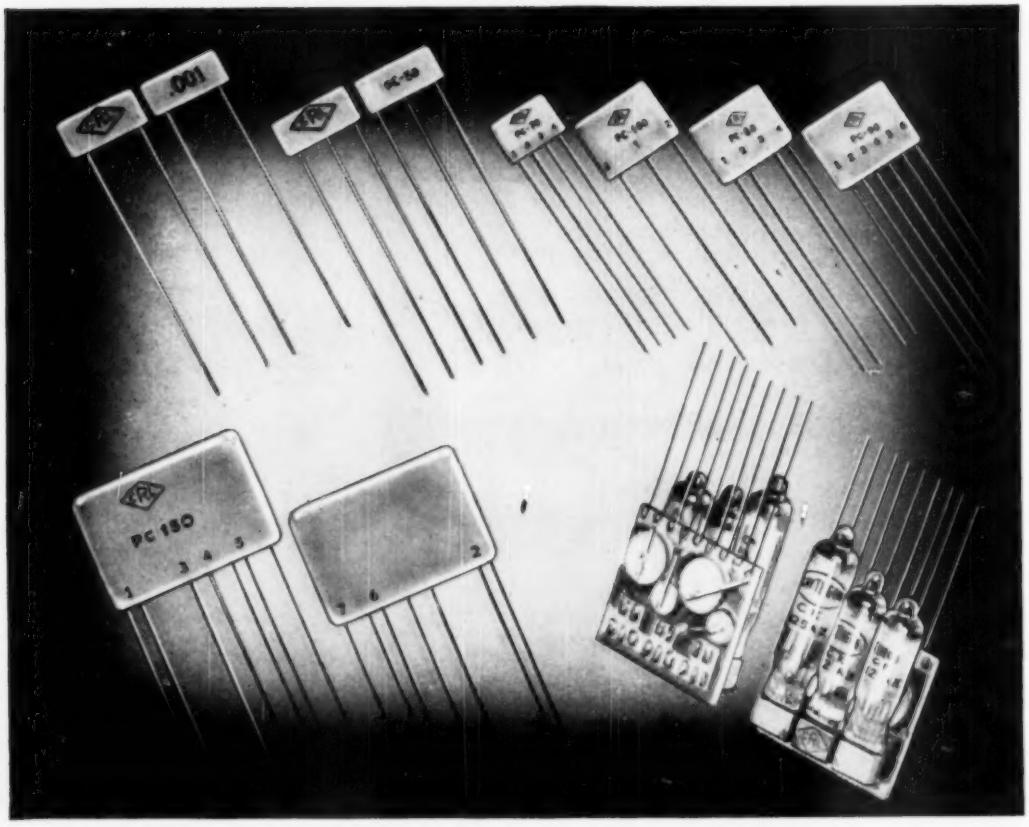
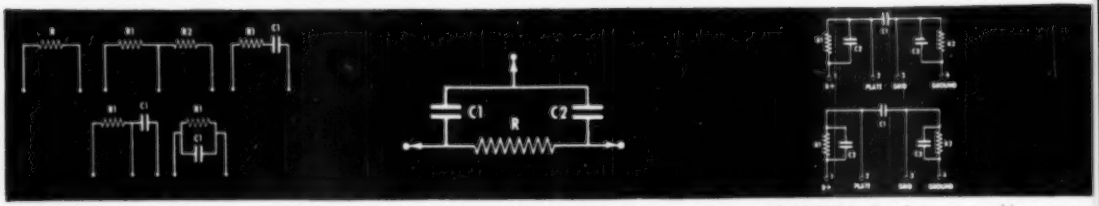


TYPICAL SCHEMATICS OF CENTRALAB PRINTED



The resistor-capacitor units diagrammed here are only $\frac{13}{32}$" x $\frac{7}{32}$" x $\frac{7}{64}$" thick maximum. These tiny units are ideal where small size is essential in low-voltage applications.

The Centralab FILPEC diagrammed here is one of the smallest multi-value components available to the industry. Specially designed for use as balanced diode filter but adaptable to variety of circuits.

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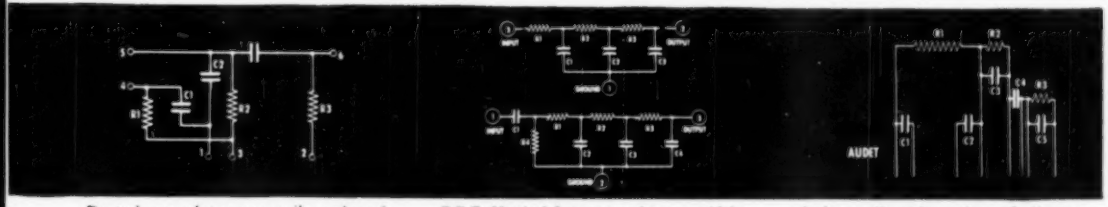

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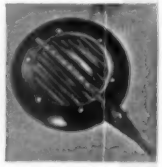

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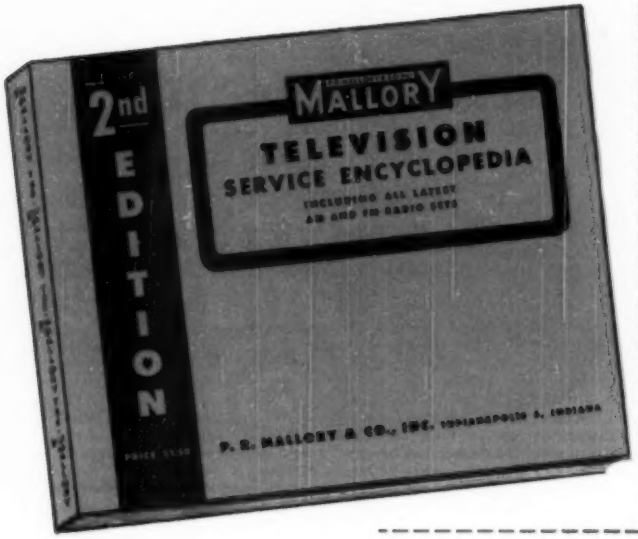

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Spot Radio News

★ *Presenting latest information on the Radio Industry.*

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

THE KOREAN CRISIS AND COLOR TV found themselves common targets of seething Congressional comments as the race to set standards reached its final stages toward the closing weeks of summer. With rumors, indicating that the Asiatic situation and our heavy defense plans might stifle a color decision, whistling through practically every office in the Capitol, legislators concerned with communications activities became quite concerned. Someone had to confirm or deny these whispers, it was felt. And someone did, in a blunt decisive way, Senator Edwin C. Johnson. As chairman of the all-powerful Senate Interstate and Foreign Commerce Committee, who sparked the color hearings, it was believed that his remarks would tell the story. The story was told in an acid letter to FCC Headman Wayne Coy, which blasted the whisperers, denouncing them as . . . "busy-body scandal mongers."

Describing the employment of the current crisis as an alibi for delay by the detractors of color television and a frantic move, the Senator declared that such thinking shows . . . "how desperate they (*rumorists*) are for any excuse for procrastination, deferment, or weasley worded proposed findings which have the deadly effect of delay itself." The Senator then added in this letter, which incidentally was believed to be so important that it was entered in the *Congressional Record*, that . . . "it is wholly unrealistic for these selfish interests to seize upon the war needs as an excuse; it indicates an utter lack of appreciation of the important part played by electronics in modern war."

In the Senator's opinion, the . . . "immediate commercial utilization of color television would be of vast aid to the defense effort in testing engine flame colors, observations of guided missiles, surveillance of various atomic processes, and in a number of other still secret processes and developments. Whether or not the Korean conflict, or even a major expansion of it, would seriously affect production in the electronics industry is beside the point."

Declaring that Korea was not part of the testimony, the fiery statesman said that . . . . "even if it were honestly believed that a decision for immediate utilization of color could not be put into effect, because of the war, the Commission has no duty or responsibility or even right to use such an anticipated development as a prop for *no decision now*, or for a proposed or tentative decision, or for anything other than a clear-cut definitive decision based on the record before it."

> EDITOR'S NOTE: *Just as we go to press we received word from Washington that the FCC has given "temporary approval" to the CBS color television system. Final decision will not be made until December 5th when RCA, CTI and others will be asked to submit any additional testimony which will convince the Commission that standards for CBS should be delayed or standards for other systems set up.*

Referring to letters sent to the FCC by the proponents of color, urging a prompt color decision, the Senator stated that these letters . . . "prove conclusively, once and for all, that the selfish interests conspiring for delays are not the pioneers who have fought the hard battle in the laboratory and expended millions of dollars to make this amazing recreational and educational development available to the American people."

Banging into the whisperers, the Senator added that these . . . "busy-body scandal mongers . . . ignore the nine months of tedious, detailed, and searching hearings only recently completed, the most intensive ever held by an administrative agency. They forget the time and money spent by *CTI*, *RCA*, and *CBS* in presenting their cases. Any further delay will place us far behind the rest of the world in this potentially phenomenal improvement of the television art."

Soon after this stinging note reached the Commission's office, Chairman Coy declared that the FCC did not intend to delay its color decision because of world problems. The chairman of the board of *RCA*, General Sarnoff, also rebuked those who had been waging a *delay war*, in a letter to the Commission, stating that . . . "On behalf of *RCA* and *NBC*, we wish to reiterate that we have not and do not favor any delay in the establishment by the FCC of commercial standards for color television. . . ."

CBS's prexy, Frank Stanton, also forwarded a strong note criticizing delay movers to the seven guardians of

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Its feather-light tip, on the end of a dual-twist cantilever arm, follows every curve and dip of the record groove with a compliance so delicate it picks up frequencies through 10,000 cycles per second! The blasting, buzz, and hum so annoying in most record reproduction are virtually wiped out. Above all—the tone fidelity of the Baton Stylus is unsurpassed by any other commercially available unit! Equipped with diamond or sapphire tip, it fits any G-E replaceable stylus cartridge.

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the ether, declaring that . . . "I would like to underscore what the record already makes clear, that *Columbia* has always wanted and now wants a prompt and definitive decision adopting a system of color television and fixing full commercial standards therefor. We are not and never have been in favor of any deferment whatever of a definitive color decision."

While in the Senator's caustic barrage of words, industry was praised for its efforts in the color push, the singular effort, of which many believe the admirer of color was particularly proud, was the Condon report, which appeared shortly before the historic letter was framed. It was this report which in its semi-official status indicated that color TV was now possible, and thus bolstered the Congressional leader's views. As stated in our report last month, the Condon Committee edict declared that the *CBS* field sequential system had reached a satisfactory state as to color fidelity, but was not likely to improve substantially, while the *RCA* system can be expected to improve, and the *CTI*, which was less fully developed, has . . . "somewhat greater possibility of future improvement."

The Condon report was met with mixed reactions by the proponents, particularly *CBS* and *RCA*, with *CBS'* vice-president, Adrian Murphy, highly critical of several sections of the review. According to Murphy, the report . . . "by dealing primarily with theoretical ultimate performances, which may or may not be achievable to some extent, obscures the comparative readiness of the respective systems to render satisfactory commercial service in the home on both local and network basis. . . . Moreover we feel that some confusion on this score results from . . . the opinions on . . . potentialities and future improvements. . . . The paragraphs referred to on the one hand do not explicitly cope with relative readiness, and on the other hand they seem to indicate, by implication, that a system has an advantage because it has more difficulties yet to overcome. This seems tantamount to implying that in the 100-yard dash a 15-second man is more promising than a 10-second man because the former has greater 'opportunity for improvement.'"

From *RCA's* lab division chief, Dr. C. B. Jolliffe, came the comment that the committee had gone . . . "out of its way to be fair" . . . and that the group was . . . "entitled to great credit for its brilliant job in presenting a clear, constructive analysis." There appeared to be one section of the report of which Dr. Jolliffe was somewhat critical, and that covered the commentary on the disc. The Condon group had cited the advantages of the filter, but according to Dr. Jolliffe, omitted the disadvantages. On this point, he declared that . . . "If disc apparatus is to aid *CBS* in the categories of color fidelity, registration,

(*Continued on page* 145)

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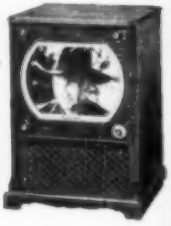

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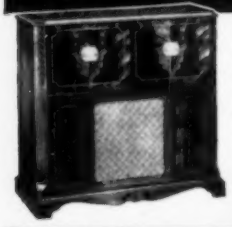

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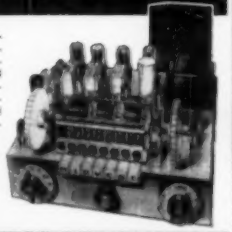

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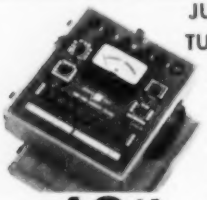

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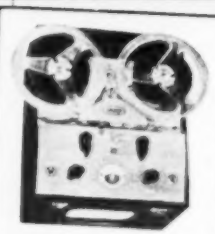

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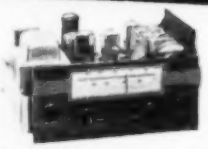
35-22614R--Shipping Weight 26 lbs. 159.50



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"Soft light and sweet music" is the soothing combination you can have from this cleverly-designed bedlamp radio. Spend pleasant evenings reading in bed to the strains of your favorite melodies. Flip off the light and relax to the radio alone. Padded, adjustable brackets let you mount the radio on any type of bed rail or headboard. The radio is a full-size, 5-tube superheterodyne, with built-in antenna and dynamic speaker. The bedlamp section contains a standard, tubular lamp, behind a curved, plastic diffusing shield, which unclips from the front of the radio to replace the lamp. The unit operates on 110 volts, AC or DC. Radio uses: 12SA7, 12SK7, 12SQ7, 50L6-GT, and 35Z5-FT (rectifier). Dimensions: 9-1/2" x 5-1/4" x 7". Shpg. Wt. 6 lbs. Our supply is limited so Order TODAY!

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AUTOMATIC—the new deluxe model HIR Alliance Tenna-Rotor is fully automatic. Turn the indicator knob and the antenna turns to any setting on the dial and stops.

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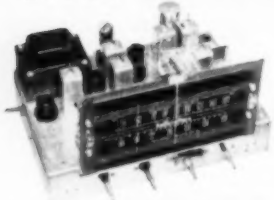

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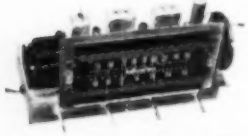

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Make your own opportunity in electronics. Start preparing at once while there is still time! The next few months can be all-important in determining your future electronics career. Write immediately for complete information. The cost is within reach of all, the terms easy.

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Within the INDUSTRY

CECIL S. ALLEN has been elected to the post of executive vice-president and general manager of *Raytheon Manufacturing Company's Russell Electric Company Division* in Chicago.

Prior to joining *Russell*, Mr. Allen was vice-president and general manager of the Pacific Coast Division of the *A. O. Smith Corporation* for two and a half years. For sixteen years he served in various capacities with the *General Electric Company* and during the war he was section engineer in *G.E.'s* fractional horsepower motor engineering division at Fort Wayne.

* * *

W. A. BUCK has been named vice-president and general manager of the *RCA Victor Division of Radio Corporation of America* . . . Election of **HARRY E. AUSTIN** as vice-president in charge of the Pacific Coast District for *RCA Communications, Inc.* was announced recently . . . *C. P. Clare & Co.*, Chicago relay manufacturer, has promoted **L. E. NOELCK** to the post of assistant sales manager . . . **CHARLES F. WATTS** has been named assistant purchasing agent in charge of television cabinet procurement for *Andrea Radio Corp.* . . . **L. M. SANDWICK** is the new vice-president and general sales manager of *Scott Radio Laboratories*. He was formerly merchandising manager of the firm . . . **J. GRAYSON JONES**, formerly chief engineer, has been named vice-president of *Conrac, Inc.*, Glendora, California manufacturer of television receivers . . . The appointment of **JOSEPH KATTAN** as distribution manager has been revealed by *Emerson Radio & Phonograph Corporation* . . . *Sylvania Electric Products Inc.* has made three new appointments of interest to the industry. **ROBERT L. McNELIS** has been promoted to the post of distributor sales representative for the Radio Tube Division. **DONALD E. SMITH** has been transferred to the renewal tube sales department, and **CURTIS K. WALL** has joined the distributor sales department of the company . . . **ALFRED S. BACKUS** has been appointed to the post of plant manager of the Clifton, New Jersey operation of *Mycalex Corporation of America* . . . The Television-Radio Division of *Westinghouse* has named **FRED S. McCARTHY** of Chicago to the post of sales promotion manager of the division . . . **WALTER F. KRAM** has joined the engineering staff of the *Ballantine Laboratories, Inc.* at Boonton, N. J. as senior engineer . . . **F. W. TIETSWORTH** has been named commercial engineer for the eastern sales region of *General Electric's* Tube Divisions. The same divisions have also appointed **G. E. BURNS** as field sales manager and **W. C. WALSH** western regional sales manager in the replacement field . . . **SAMUEL J. SPECTOR**, president of the *Insuline Corporation of America*, was elected to the board of directors of the 1951 Radio Parts and Electronic Equipment Shows, Inc. . . . **RON MERRITT** is the new field sales agent for the Instrument Division of *Allen B. Du Mont Laboratories, Inc.* He will cover the Northwestern territory . . . *Reeves Soundcraft Corp.* of Long Island City, N. Y. has appointed **HARRY P. WESTON** as executive vice-president of the firm. He was formerly with *Graham-Paige Corp.* . . . **REAR ADMIRAL C. A. RUMBLE**, USN (Ret.) has joined the *Erie Resistor Corporation* as manager of its Washington Division . . . **T. R. MATHEWS** has been named distributor manager of the Radio-Television Division of *Stromberg-Carlson Company* . . . **JOHN GRAY**, a recent graudate from the University of Illinois School of Engineering, has been named to head the Industrial Sales Correspondence department of *Simpson Electric Company* of Chicago . . . **JACK STEVENS** has been elected vice-president of the *Geo. Stevens Mfg. Co., Inc.* of Chicago. He has been with the firm since 1942 . . . **BEN WILLIAMS** is the new general manager of *Richmond Television Corporation*, manufacturer of the *Natalie Kalmus* television receiver line . . . **J. M. TAYLOR** has joined the *Whitney Blake Company* of New Haven, Conn. as assistant sales manager for that wire firm . . . **DAN DEANER**, a well-known figure in the radio and television sales field, has joined *International Television Corporation* as sales manager.

* * *

MATTHIAS LITTLE has been elected president of the *Quam-Nichols Company*, Chicago speaker and electronic components manufacturer. He succeeds James P. Quam who was elevated to the post of chairman of the board.

Mr. Little, who joined the company in 1930, has been vice-president of the firm since 1946. During the war he served as a major in the air force.

Mr. Quam plans to devote a greater part of his time to the development

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★ Complete Stocks! ★ Quick Delivery!

New Senior VoltOhmyst

The WV-97A has a range of usefulness extending beyond that of any other instrument in the field. The new Senior VoltOhmyst measures dc voltages in high-impedance circuits, even with ac present. It reads the rms values of sine waves or recurrent pulses, even in the presence of dc. Its electronic ohmmeter has a range of ten billion to one. Like all RCA VoltOhmysts, it features high input resistance, electronic protection from meter burn-out, zero-center scale for discriminator alignment, molded-plastic meter case, a 1-megohm isolating resistor in the dc probe, and sturdy metal case for good rf shielding. 25P21527, Wt. 12 lbs..... **$62.50**

RCA FM Folded Dipole Antenna — $5.59

Excellent for use in low-signal strength areas. Specially designed for FM receivers with 300-ohm inputs. Lightweight aluminum construction. Ready for mounting. Complete with 5 ft. mast. 28N21816: Shpg. Wt. 5 lbs.

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A $22.00 Value for $15.00
Buy the entire series of RCA Victor Service Data Books from Lafayette for $15.00—you save $7.00! Pays for itself over and over in time saved and service jobs speeded! No. 23F20197. Shipping Weight: 6 lbs.

RCA TV DATA BOOK $1.50
Authoritative, easy to follow alignment procedures, circuit and service data. Approx. 100 pages. 23F19904: Shpg. Wt. 1 lb.

RCA TV COMPONENTS .25
Gives complete technical, installation and application data on RCA TV components for use with 16AP4. 32 pages. 23F19903: Shpg. Wt. ¼ lb.

RCA RECEIVING TUBE MANUAL 35
Complete technical data on all glass and metal receiving tubes, plus theory and operation of each unit. 257 pages. 23N19963: Shpg. Wt. ½ lb.

RADIOTRON DESIGNERS HANDBOOK 1.22
New manual sponsored by RCA for the set designer. 365 pages. 23N19680: Shpg. Wt. 1 lb.

genuine RCA TV components

Stock No.	RCA No.	Description	Price ea.
6F5977	201D1	Deflecting Yoke	4.41
6F5978	201D2	Deflecting Yoke	7.64
6F6002	201D3	Deflecting Yoke	8.76
6F6003	201D12**	Deflecting Yoke	4.41
6F5979	201R1	Width Control	.41
6F5980	201R2	Width Control	1.29
6F5981	201R3	Horizontal Linearity Control	.47
6F5877	201R4*	Width Control	.59
6F5878	201R5*	Horizontal Linearity Control	.71
6F6004	201T6**	Power Transformer (30-tube)	15.29
6F6005	201T7**	Power Transformer (24-tube)	12.35
6F6006	201T8**	Power Transformer (21-tube)	11.17
6F6007	201T9*	Power Transformer (27-tube)	12.35
6F6008	201T10*	Power Transformer (27-tube)	12.35
6F5982	201X1	Yoke Mounting Hood	.76
6F5983	202D1	Focus Coil	4.41
6F5876	202D2*	Focus Coil	6.47
6F5984	203D1	Ion-Trap Magnet	3.82
6F6009	203D3**	Ion-Trap Magnet (PM type)	1.23
6F6010	203R1**	Hor. Osc. & Sync. Control Coil	1.06
12F10168	204L1	Filament Choke	.12
6F5986	204T2**	Vertical Output Transformer	2.94
6F5970	204T3	Horizontal Output	7.06
6F6011	204T9**	Vertical Defl. Output Transf.	2.65
6F5971	208T1**	Horizontal Block. Osc. Transf.	2.29
6F5972	208T2**	Vertical Block. Osc. Transf.	1.62
6F5973	208T3	Horizontal Block. Osc. Transf.	1.62
6F5974	208T8**	Horizontal Sync-Disc. Transf.	1.35
6F6012	208T9**	Ver. Blocking Osc. Transformer	1.47
6F5975	211T1	Horizontal Output Transformer	3.29
6F5976	211T2	Horizontal Output Transformer	11.17
6F6013	211T3	Hor. Defl. Output & HV Transf.	3.29
6F5875	211T5*	Hor. Defl. Output & HV Transf.	5.59

**For 16" set using 16AP4 TV Tube. ** Used with both 16AP4 and 10BP4 Tubes. Prices shown are less 5% discount.*

RCA Repl. T.V. Controls

Stock No.	RCA No.	Sect. 1	Sect. 2	Price ea.
6N5883	71443	20	10*	97
6N5884	71446	10,000	1 meg.	2.50
6N5885	71784	500,000	10,000	2.53
6N5886	71971	1,000	50,000	1.47
6N5887	72758	1 meg.	50,000	1.47
6N5890	73193	10,000	500,000	1.82

**Single tapped control. Prices shown are less 5% discount.*

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of new products in the speaker and television fields. He is the holder of many electronics patents. His new post will also enable him to take an active part in several of the trade association activities in which he is most interested.

* * *

E. H. ULM, formerly sales engineer for the Electronics Division of *Sylvania Electric Products Inc.* has been named merchandising manager of that division.

He joined the staff of the Electronics Division in 1945 as a sales engineer. Prior to that time Mr. Ulm was associated with the field engineering force of the Radio Division of the *Western Electric Company* where he served as an instructor in radar and sonar. During 1943 he served as an anti-submarine warfare field engineer for the Division of War Research, Columbia University.

Mr. Ulm is a member of the IRE, the Radio Club of America, and the AIEE.

* * *

TELEVISION EXPERTS from nine countries recently met in Geneva, Switzerland, under the chairmanship of Dr. W. Gerber of the Swiss General Post Office to discuss the matter of establishing detailed standards for telecasting.

Delegates from Belgium, Denmark, Italy, the Netherlands, Sweden, Switzerland, France, the United Kingdom, and the U. S. were present. The purpose of the meeting was to establish standards for 625-line television systems. While the U. S., France, and the United Kingdom are telecasting on other standards, it is possible that the other countries represented will adopt the 625-line standard.

* * *

RADIO CORPORATION OF AMERICA has announced that it has voluntarily relinquished four of its trademarks to public domain.

The U. S. Patent Office has been asked to cancel *RCA's* registration of the tradenames "Iconoscope," "Kinescope," "Orthicon," and "Acorn." According to Frank M. Folsom, president of the company, the industry is now using these tradenames in a generic and descriptive manner and *RCA* is willing that they be so used.

* * *

CALVIN SILVERMAN, 15-year old senior from Huntington High School, Long Island, was presented the first prize in the Long Island Science Congress competition as the representative of the school's Radio Amateur Club.

The club was awarded an *Eico* Model 511-K volt-ohm-milliammeter kit for its achievement in the construction and operation of a modern 300 watt, all-band amateur transmitter.

* * *

SOL PREDEGER has been appointed vice-president of *Majestic Radio & Television, Inc.* of Brooklyn, New York. He is director of purchases for *Majestic* and also for *Garod Radio Corporation.*

Mr. Predeger has been associated with the two companies for a period of 13 years as director of all purchasing activities. He has also served in a similar capacity with *Fada.* A pioneer in the radio industry, he has served various companies for over 20 years.

Mr. Predeger's appointment is the first step in the company's plan for a general expansion in the purchasing department. *Majestic* is contemplating further additions to executive personnel in view of increased production schedules, according to Leonard Ashbach, president of the firm.

* * *

ADMIRAL CORPORATION, Chicago television manufacturer, has received the merit award of the American Society of Industrial Engineers, Detroit, for leadership in research, engineering, design and manufacture in the radio and television fields. The award is made in limited numbers each year to those companies which, in the opinion of the board,

(*Continued on page* 122)

Television camera with the eyes of a cat!

Why an image orthicon camera can see with only the light of a match

No. 9 in a series outlining high points in television history

Photos from the historical collection of RCA

Although dramatic action, *in television plays, is often presented in the dimmest light – no detail is missed by the RCA image orthicon camera.*

• Show any camera fan the things a television camera is asked to do, and you'll leave him gasping!

Accustomed to using flash bulbs and floodlights—or taking time exposures in dim light—the still photographer is tied to the limitations of lens ratings and film speed. But a television cameraman operating the RCA image orthicon camera gets sharp, clear pictures—*in motion*—in places where lack of light would *paralyze* the most costly "still" camera.

The secret, of course, is that the picture signals created within the RCA image orthicon camera can be intensified millions of times for transmission.

Youthful ancestor of this supersensitive instrument is the *iconoscope tube* invented by Dr. V. K. Zworykin, of RCA Laboratories. It was television's first all-electronic "eye"—without any moving parts, presenting no mechanical problems.

Here, in a testing battery *at RCA Tube Plant in Lancaster, Pa., RCA image orthicon pick-up tubes get the final seal of approval from an engineer.*

Basing their research on principles uncovered by Dr. Zworykin's iconoscope, RCA scientists were then able to develop the image orthicon pick-up tube. Although simple to operate, and virtually fool-proof, it is actually one of the most complex and compact electronic devices ever developed.

Within its slim length—not much bigger than a flashlight—are the essentials of three tubes, a phototube, a cathode ray tube, an electron multiplier. The phototube converts a light image into an electron image, which is electrically transferred to a target and scanned by an electron beam to create a radio signal. The electron multiplier then takes the signal and greatly amplifies its strength so that it may travel over circuits leading to the broadcast transmitter.

Inside the image orthicon tube, more than 200 parts are meticulously assembled. There's a glass plate thinner than a soap bubble . . . a copper mesh pierced with 250,000 tiny holes to the square inch. A piece of polished nickel pierced with a hole so small you couldn't thread it with a human hair!

The image orthicon television camera, as it has been developed by scientists at RCA Laboratories, is now 100 to 1000 times as sensitive as its parent—the iconoscope . . . and in the dark, sees almost as clearly as the keenest eyed cat!

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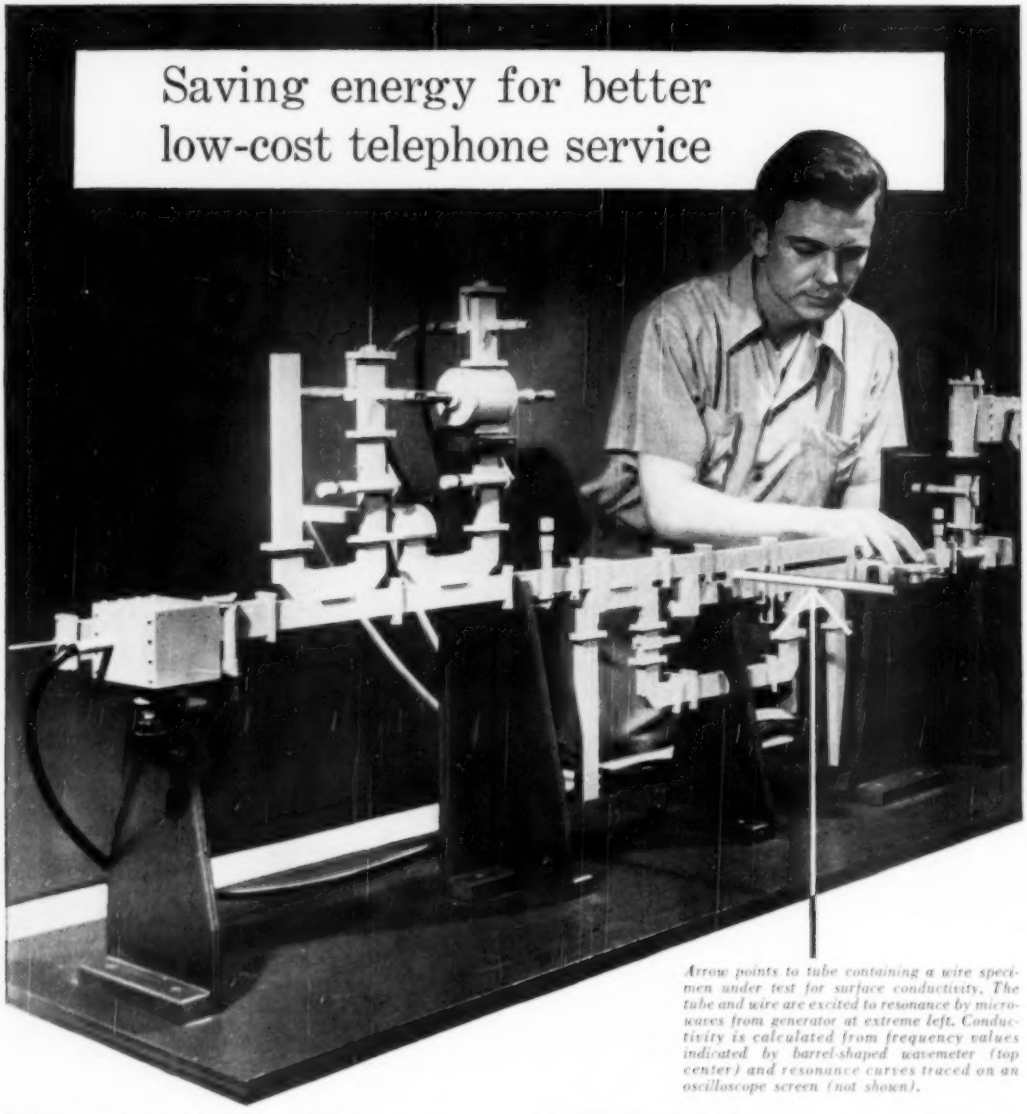

Arrow points to tube containing a wire specimen under test for surface conductivity. The tube and wire are excited to resonance by microwaves from generator at extreme left. Conductivity is calculated from frequency values indicated by barrel-shaped wavemeter (top center) and resonance curves traced on an oscilloscope screen (not shown).

In the waveguides which conduct microwaves to and from the antennas of radio relay systems, current is concentrated in a surface layer less than 1/10,000 inch thick, on the inner surface of the waveguide. When these surfaces conduct poorly, energy is lost.

To investigate, Bell radio scientists devised exact methods to explore this skin effect at microwave frequencies.

Scratches and corrosion, they found, increase losses by 50 per cent or more. Even silver plating, smooth to the eye, can more than double the losses of a polished metal. Very smooth conductors, like electropolished copper, are best. An inexpensive coat of clear lacquer preserves initial high conductivity for many months.

Energy saved *inside* a microwave station is available for use in the radio-relay path *outside*. So stations can sometimes be spaced farther apart, and there will always be more of a margin against fading. Here is another example of the practical value of research at Bell Telephone Laboratories.

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See the beautiful models now available in the new 1951 Raytheon line. And remember: Raytheon is dependably built for dependable performance!

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PROOF! Backed by a liberal one-year Warranty.

PROOF! Backed by the Underwriters' Laboratories Seal!

PROOF! Made by a leader in electronics for 25 years.

***Dependably* Built for *Dependable* Performance**

As Advertised in Life, Good Housekeeping, Saturday Evening Post

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G I—13-CHANNEL TELEVISION TUNER

For replacement or construction work. Capacity type tuner with fine tuning control. Using 3—6J6 tubes. Input for 300-ohm line. One of the finest front ends ever built.

Each.....**$6.95** less tubes
Lots of 3..... **6.50** each

VOLUME CONTROL STEAL

250,000 / 500,000 / 1 meg. / 2 meg. — With switch—2½" milled shaft **39¢** ea.
Lots of 10.....**$3.72**
Asst. of 25..... **8.74**

Standard Type Replacement Phono Cartridge

All New—All Guaranteed

Type No. 1 will replace Shure W58A
Webster N10
Astatic L70

Price—only **$1.83** ea. Lots of 10 **$17.90**

Type No. 2 will replace Shure W56A
Webster N10
Astatic L-72

Price—only **$1.99** ea. Lots of 10 **$18.90**

CERAMICON CONDENSERS

Standard Manufacture
Kit of 100 most often used ceramicons—now only.....**$4.95**

GT TUBE CARTONS

Sturdy—Many Uses.
Box bulk tubes, spare parts, nuts and bolts.
$ .79 per 100
4.95 per 1000

KNOB ASSORTMENT

Includes half push on and half set screw knobs. All used often.
100 knobs only.....**$1.89**

MOST POPULAR VIBRATORS

Covering 95% of all uses at great savings.
Standard 4-prong.....**$1.19** ea.
10 for **$10.50**
Delco 4-prong.....**$1.29** ea.
10 for **$11.90**
Buick Vibrator.....**$2.59** ea.
10 for **$22.50**

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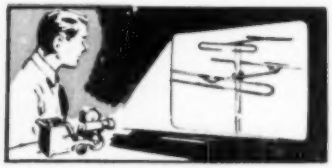

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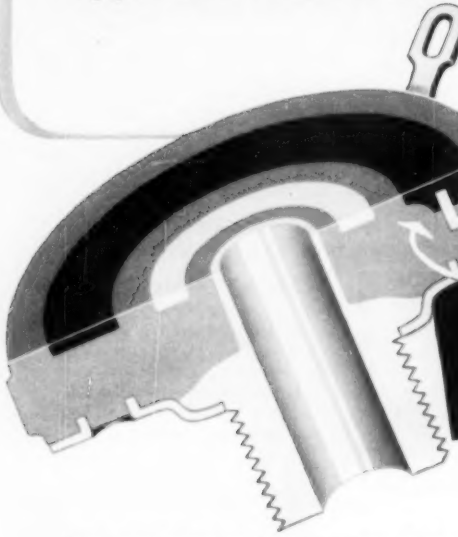

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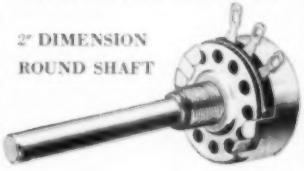

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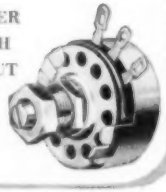

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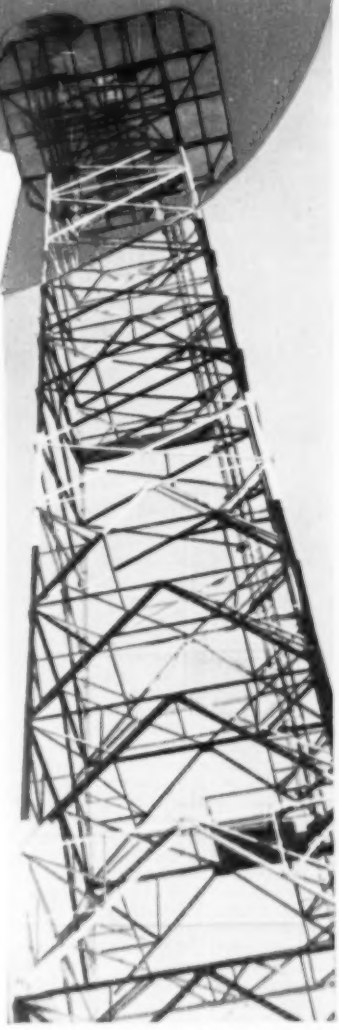
The MICROWAVE ERA BEGINS

Western Union's microwave tower, Neshanic, N. J. Upper antennas (truncated) are part of Philco's 6000 mc. microwave relay system. Lower parabolic antennas are part of RCA's 4000 mc. microwave relay system. Diversity receiving antenna may be seen lower left.

Top section of "H" fixture microwave antenna-supporting structure. 100 ft. wood poles are used. Plane reflectors, 4 by 6 feet, are mounted on top and reflect microwave beam from 4 ft. parabolic antennas below. This is part of the Rock Island's microwave communications system from Norton to Goodland.

By
LEO G. SANDS
Sales Engineer
Philco Corporation



A.T.&T. microwave tower at repeater station located between Richmond and Norfolk, Va. Philco 10 ft. parabolic antenna is on top of tower. Waveguide is used to feed units.

Microwave relays will someday replace cross-country overhead telephone lines. Equipment described will be displayed at the 27th annual meeting of the Communications Section of the Assn. of American Railroads meeting at French Lick, October 17-19.

ALL over the country, towers topped by queer looking mirror-like reflectors or parabolic antennas are arising. These towers, spaced from 15 to 50 miles apart, are spelling the doom of the overhead telephone wires that follow almost every highway and railroad track. The complete elimination of the pole line is still far off, but construction of new open wire pole lines, except for local distribution, seems unlikely.

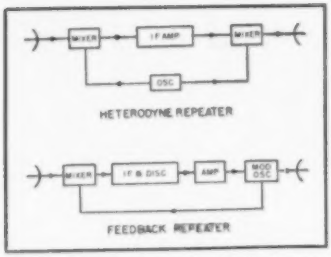
For several years, there has been talk of the day when beamed radio would start taking the place of wires for point-to-point overland communications. That day has arrived. Although the microwave art is not new, inexpensive equipment was not available until 1949 and very few systems had been ordered prior to 1950.

In the prewar year 1940, a radio relay system was installed by *Philco* engineers to bring television programs to New York and Philadelphia. This relay link operated in the vicinity of 200 megacycles. In 1947 this pioneer radio relay was replaced with a 1400 megacycle microwave system. During the war, the armed services made considerable use of microwave and u.h.f. equipment for point-to-point communications. Today, television broadcasters make use of microwave links to transmit television signals from their studios to the television transmitters.

Although it is comparatively easy to build microwave transmitters and receivers, the biggest problem was the design of repeater equipment for long haul relay systems. A long microwave relay system consists of two terminals and a large number of intermediate repeaters. These repeaters must be capable of receiving and retransmitting microwave signals with a minimum of distortion to provide high quality circuits and very little crosstalk.

The ideal repeater would consist of a microwave amplifier in which demodulation and remodulation does not take place. However, such a repeater has not yet been developed. Currently available repeaters fall into three classifications: (1) a transmitter and receiver connected back-to-back; (2) a heterodyne repeater; and (3) a feedback repeater. All three types have merit and can be used with multiplexing systems compatible with the specific type of repeater.

The first commercial application of negative feedback at microwave frequencies is incorporated in the feedback type microwave repeater developed by *Philco*. In this repeater, the output of the receiver is fed back to the receiver's own local oscillator klystron, causing it to track the incoming frequency modulated signal. The output of the klystron is divided so that a small percentage of this output is injected into the mixer of the



Block diagram show simplified circuitry of two types of microwave repeater units.

superheterodyne type receiver and the major portion of the output is fed into the antenna system as the outgoing signal. To provide duplex operation, two repeater units, one for each direction of transmission, are multiplexed into common antennas. Only a single klystron-type tube is required for both transmission and reception in a single direction.

A back-to-back type of microwave repeater consists of a receiver whose output is fed to a transmitter. For duplex operation, two transmitters and two receivers are required at each repeater station. In this type of repeater at least two microwave oscillator tubes are usually required for each direction, one as the receiver local oscillator and the other in the transmitter.

The heterodyne type repeater is not commonly used in communications relay systems due to its cost and complexity. However, it has found wide use in television relays. Here a comparatively low frequency signal produced by beating the incoming modulated microwave signal with the output of the receiver local oscillator is amplified. This low frequency signal (v.h.f.) is used to beat against a microwave oscillator to produce a microwave signal at the sum or difference of the two frequencies.

Several types of tubes are used as microwave signal sources and include lighthouse tubes, planer triodes, magnetrons, and klystrons. Power outputs of these tubes vary from a few milliwatts to several watts.

Several groups of radio frequencies in the microwave region have been allocated by the Federal Communications Commission for point-to-point use by various industries, transportation services, public safety organizations, broadcasters, and communications common carriers. The 6000 megacycle band offers many advantages, such as high antenna gain, adaptability to simple circuitry, availability of reliable long-life tubes, and excellent propagation characteristics.

Antennas with parabolic reflectors are generally employed. The effective power gain, for example, of such an antenna with a dish of four foot diameter is in the order of 34 db. at 6500 megacycles. This means that a one watt transmitter will effectively radiate the equivalent of a 2500 watt signal. A waveguide is often used for connecting the antenna to the microwave transmitter, receiver, or repeater. Alternatively, passive reflectors are used in lieu of long waveguide runs. A plane reflector, rectangular in shape, is mounted atop a tower or other suitable supporting structure and the parabolic antenna is mounted near the ground aimed at the reflector. The signal is bounced off the mirror-like reflector in the desired direction in the same manner as a beam of light is reflected by a mirror. In practice the parabolic antenna dishes are usually mounted on brackets on the roof of the equipment shelter. As the antennas are exposed to the elements, heating facilities are provided for feed horns and antenna dishes when used in cold climates. With the antennas mounted outdoors, there is the possibility that the dishes may be eventually filled with leaves, dirt, or snow. Furthermore, the end of the feed horn makes an attractive target for the hunter. To provide greater protection for the paraboloids and feed horns, *Philco* engineers have recently designed a new type of microwave equipment shelter in which the antennas are mounted indoors under the roof. Windows made of a special type of pressed Fiberglas, virtually transparent to microwaves but opaque to light, are installed in the slanting roof of the shelter. The antennas are aimed through these windows at the plane reflectors on the tower. To prevent frosting or the accumulation of snow, thermostatically controlled infrared lamps are used to heat the Fiberglas windows.

One antenna with or without a plane reflector is used at terminals for simultaneous transmission and reception. Two antennas are required at repeater stations in combination with waveguide feeds or plane reflectors, each of which is used for transmitting and receiving simultaneously in one direction to and from the adjacent repeater or terminal.

The popular term for a single link, the space between adjacent repeaters or terminals is a "hop." For example, a three hop system consists of two terminals and two repeaters. The signal originating at a terminal on frequency f_1 is retransmitted by the first repeater on frequency f_2 and is retransmitted again on frequency f_1 by the second repeater. The signal arrives at the far terminal in three hops. For duplex operation, another signal travels simultaneously in the reverse direction.

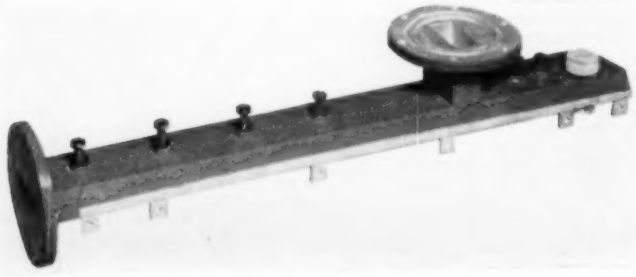
The practical length of a hop is determined by the heights of the antenna supports, terrain, transmitter power, receiver sensitivity, and antenna gain, coupled with good engineering practice. Line-of-sight conditions are not good enough except for very short hops. At least 50 feet of clearance above trees is considered desirable. Hops varying in length from 15 to 50 miles are common. Longer hops where sufficient terrain clearance is available could be considered, however, long hops are more apt to suffer from fading.

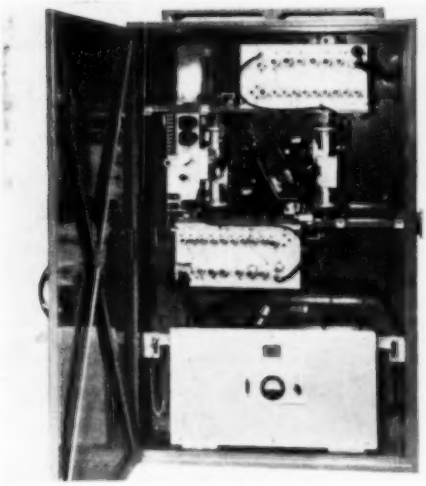
A properly designed microwave relay system makes allowances for fading. When frequency modulation of the microwave signal is employed, shallow fades go unnoticed. A microwave system with a 30 db. fading margin provides a continuous signal without serious degradation of circuit quality even during deep fades. In the 2000 megacycle band, deep fades are not as frequent as in the 6000 megacycle band. However, the higher antenna gain available at 6000 megacycles permits designing a system with a greater fading margin, with the result that operation in either band is almost identical. The hop length at 2000 megacycles or 6000 megacycles can be the same, as here again the much greater antenna gain at the higher frequency more than compensates for the slight difference in propagation characteristics.

The width of the transmitted beam from a four foot parabolic antenna at 6000 megacycles is three degrees. Although this appears to be a very narrow beam, 25 miles out it is over a mile wide at the half power points. Much emphasis has been placed on tower twist, but an analysis of the facts reveals that tower rigidity is not as important as has been popularly supposed. As fading seldom occurs at the same time as high wind velocity, the fading margin also compensates for tower twist.

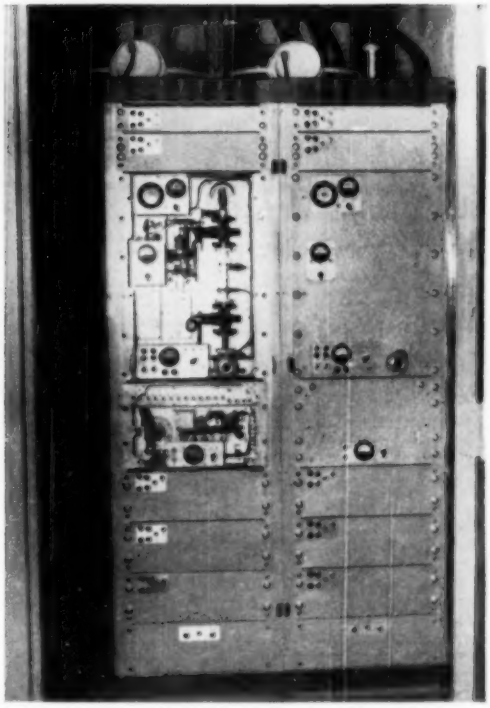
The basic microwave system is ca-

A four-section r.f. filter for a Philco microwave receiver. This is part of the Philco CLR-5 repeater for use in 6575-6875 mc. band. Tuning slugs are pretuned and sealed at factory.





Philco CLR-5 microwave repeater for 6575-6875 mc. band. Two complete one-way feedback repeaters and common power supply are housed in a single cabinet. The microwave carrier is frequency modulated. It may be used with frequency-division or time-division multiplex terminals. Only one klystron is required for each direction. The same klystron serves both as the receiver local oscillator and the FM transmitter tube.



Philco TLR-2 microwave repeater for television service as used by Western Union. A similar unit is used by American Telephone & Telegraph Company in its microwave relay system.

pable of a modulated intelligence bandwidth of considerable proportions. To transmit several simultaneous voice conversations, musical programs, telegraph messages, etc., the modulation acceptance band of the microwave system is subdivided by means of multiplex channelizing equipment. These fall into two general classifications, frequency-division and time-division multiplex systems.

The most common form of frequency-division multiplexing device is the standard telephone wire line carrier terminal employing AM with single sideband transmission and with the carrier suppressed. This type of channelizing equipment which is very economical with bandspace may be used with single hop systems or with multiple hop microwave relay systems employing repeaters which introduce very little distortion. As the carrier is suppressed, this type of multiplex equipment lends itself to party-line service on a bridging basis. Telephone carrier terminals of the single sideband type but without suppression of the carrier may be used for deriving through circuits but not bridged party-line channels.

Another form of frequency-division multiplex system is the FM subcarrier which lends itself well to microwave applications where economy of bandspace is not important. The FM subcarrier is not as critical of repeater distortion as is the single sideband suppressed carrier, hence it may be effectively used with the back-to-back type of repeater. However, its extravagant use of bandspace does limit the number of channels that can be derived.

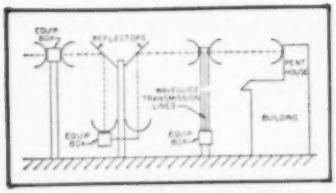
Several types of time-division multiplexing systems have been developed, making use of pulse amplitude modulation, pulse time modulation, pulse position modulation, pulse width modulation and pulse code modulation. Pulse amplitude modulation, popularly referred to as P.A.M. provides high quality voice circuits with a minimum of crosstalk and with economical use of bandspace. For example, a 32 voice channel P.A.M. multiplex terminal requires less than 300 kilocycles of bandspace. With P.A.M. it is possible to provide party-line circuits as well as through trunk circuits. Individual voice channels may be dropped off and injected at intermediate microwave repeaters without degradation of the channel.

A cost analysis reveals that for systems requiring four or fewer channels, particularly when many drop-offs are required, frequency-division multiplexing is less expensive, whereas in systems with a greater number of voice channels, time-division multiplexing can be provided at less cost. Unless otherwise specified a channel is a voice channel 300 to 3300 cycles wide. Telegraph, teleprinter, telemeter, and supervisory control channels require much less bandspace than a voice channel. When a frequency-division multiplexing system is used for deriving voice channels, narrow-band carriers for on-off transmission, such as telegraph carriers, are generally applied directly to the microwave equipment modulation input. In time-division systems, a single voice band may be sub-divided to handle from 8 to 16 AM or frequency-shift telegraph or telemeter carriers.

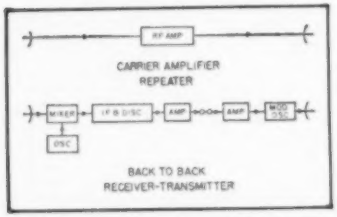
With the exception of communications common carriers, the channel requirements of most potential users of microwave communications systems does not approach 32 voice channels. Manufacturers are offering multiplex systems with 3, 4, 5, 8, 10, 12, 16, 20, 24, or 32 voice channels as required by the user. Some of the equipment being offered is expandable in steps of 1 or 4 voice channels.

To provide compatibility with telephone systems the multiplex terminals must be provided with suitable termination equipment. A two-way voice channel normally terminates on a four-wire basis, two to the transmitter input and two from the receiver output, so that a hybrid network is required to provide two-wire termination which will permit connection into a switchboard or a conventional telephone instrument. In addition, provision must be made for ringdown or dial signaling.

Although the microwave industry is just starting to grow, great progress has already been made in the past year. The first railroad-operated mi-



How microwave signals are relayed.



Block diagram of carrier amplifier repeater and back-to-back receiver-transmitter.

crowave communications system to be established on a permanent basis has been installed by the *Chicago, Rock Island and Pacific Railroad* along its Denver to Chicago main line. This 5 hop pilot system between Norton and Goodland, Kansas will supplement and perhaps eventually replace wire line comunications facilities in an area where snow, wind, sleet, and dust raise havoc with pole lines. Initially, the *Rock Island's* 6000 megacycle microwave link, 106 miles in length, will provide facilities for a train dispatcher's party-line telephone channel, a party-line message telephone channel, a local party-line telegraph circuit, and four through telegraph circuits.

The *Santa Fe Railway System* is installing a 6000 megacycle microwave communications system to provide additional communications facilities between Beaumont and Galveston, Texas. Eight voice channels derived by pulse amplitude modulation will be provided. Three unattended repeater stations are to be installed on the Bolivar Peninsula to make up a four hop relay system. To assure uninterrupted communication, standby microwave equipment will be provided at both terminals as well as at the repeaters. An automatic fault-alarm system will advise maintenance personnel at Galveston of equipment or primary power failures as well as identification of the station requiring attention.

In the petroleum industry, a number of pipe line companies are installing microwave relay systems to provide direct communication between pumping stations, regional offices, and for remote control of system-wide v.h.f. mobile radio systems. The *Humble Pipe Line Company* is to install a 6000 megacycle microwave communications system along 400 miles of pipe line between Houston and Kemper, Texas. Two terminals and eighteen intermediate repeater stations will make up the *Humble* relay system. Pulse amplitude modulated multiplex equipment will provide eight voice channels of which one to four will be dropped off at intermediate repeaters.

The Bonneville Power Administration of the United States Department of the Interior has awarded contracts for equipment for a vast microwave relay system which will blanket the State of Washington. In circuit miles, this will be the largest microwave system ordered to date for non-common carrier service. The Bonneville communications network will also make use of pulse amplitude modulation for deriving up to 24 voice channels. In addition to telephone facilities, the microwave system will also be used for power line relaying, remote control, and the locating of faults along power transmission lines.

For relaying of television programs, a number of microwave relay systems have already been installed and many more are projected. A 6000 megacycle microwave link installed by the *Western Union Telegraph Company* has been in continuous operation for over two years. This link extends from the Chrysler Building in New York to the P.S.F.S. Building in Philadelphia via two intermediate repeaters located at Neshanic and Mt. Laurel, N. J. Paralleling this link is the *Philco*-owned television relay which links the Empire State Building in New York with the WPTZ transmitter at Philadelphia. One intermediate repeater at Mt. Rose, N. J., joins the two terminals.

The *American Telephone & Telegraph Company* has a number of microwave relay systems in operation and according to the newspapers many more are planned. In April of 1950, a 6000 megacycle microwave relay system was placed in service between Richmond and Norfolk, Virginia, by the *Bell System* to feed network TV programs to the Hampton Roads area.

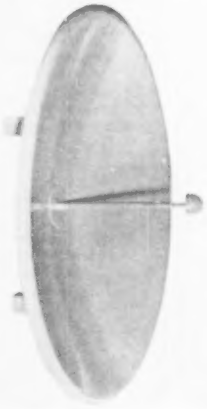
It is obvious that the microwave relay art has emerged from the experimental stage to become a vital part of the nation's communications system. In times of national emergency, microwave relay systems can be used to augment existing wire line facilities and they can be installed in much less time. Economically, wire lines cannot compete, as the cost of a microwave communications system runs from only $400 to $800 per mile. The current estimated cost of building a two-wire pole line runs from $800 to $1500 per mile. A pair of wires will provide one telephone circuit unless multiplexed. The number of channels that can be derived from a single pair of wires is limited by electrical losses. Multi-channel carrier equipment for wire line telephony is more expensive and more complex than microwave multiplex equipment.

Performance-wise, the microwave relay, being less vulnerable to storms, should provide greater reliability than overhead wire lines. Furthermore, it will carry more types of intelligence and can be expanded more readily and at lower cost. Microwave systems have provided uninterrupted service during snow, sleet, and wind storms which have prostrated wire lines. With well designed equipment and adequate preventive maintenance, reliability approaching 100% can be attained.

The year 1950 will be recorded historically as the year the microwave relay made its impact felt. —30—

Lower section of "H" fixture antenna support and microwave equipment shelter. This Philco Type CLR-5 microwave repeater and emergency gasoline engine-driven power generator are housed within the prefabricated concrete slab building. A pair of 4 ft. parabolic antennas are mounted on the roof.

Four foot parabolic antenna for the 6575-6875 mc. band. The unit has a three degree beam and an effective power gain of 34 db.



TV SHOP ON ROLLERS

Only one completely equipped test bench is required with this unique and time-saving servicing system.

By ROBERT HERTZBERG

A UNIQUE method of speeding up service jobs and saving the back muscles of the technicians doing the work has proved highly successful in the shop of *Tele-Vuers Service Center, Inc.*, of Bloomfield, N. J., one of the largest and busiest exclusive TV organizations in the East. Each chassis requiring attention is placed on a small, individual table measuring 2x3 feet and equipped with ball-bearing casters on the legs. The shop manager puts the service notes or schematic diagram alongside the set. The table is fitted with a.c. power outlets and antenna posts, with flexible leads attached. When any one of the dozen technicians in the shop is ready, he simply pushes the table over to his chair position against a wall, where he plugs in the power and antenna connections.

About 90% of the servicing operation is done with the aid of nothing more than a high-resistance multimeter, according to Robert O. Lewis and Joseph Werner, co-owners of the center, which employs 55 people and handles more than 14,000 contracts. If a set requires alignment the table is pushed over to a corner of the shop where a complete assortment of signal and marker generators, scopes, etc., is available on another table. When a set is given a final OK, it is wheeled into another room containing a large row of sturdily-built cubbyholes, transferred to one of the latter, and tagged for release.

Because the chassis remains on one table from the time it is "put into work" until the time it goes on the shelf, a great deal of effort is saved and much double-handling is eliminated. There are no fixed benches of the conventional type anywhere in the shop.

The tables are of very simple construction. The legs are 2x4's, the side braces and the bottom shelf are ¾-inch shelving, and the top is a solid piece of ¾-inch plywood. Regular furniture casters permit the largest and heaviest receivers to be pushed around with ease. Two dozen of them are about enough in a shop of a dozen men; that is, there is always one set waiting for a technician while he is working on another.

—30—

Conventional service benches have been completely eliminated in the shop of Tele-Vuers Service Center, Inc. The chassis remains fixed on table—if technician wants to work on any part of the set he merely swings the table around. The loudspeaker on table is part of the shop intercom system. A multimeter on the table is the main servicing tool. For alignment jobs and more complex servicing procedures the table can be rolled over to single test bench which is equipped with marker and signal generators, a square-wave generator, v.t. v.m., and scope. When sets have been serviced or are awaiting servicing they are housed on special racks that keep them safe and out of the way. A large tag on each set carries the full "case history."

PHOTOELECTRIC Control for Industry

The electric eye, probably best known for its novelty uses, is an important industrial "tool."

By
ED BUKSTEIN

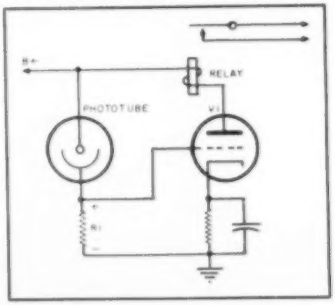
Fig. 1. Bottled beverage inspection. Each bottle passes between light source and bank of phototubes. Foreign matter affects light, operating reject relay.

THE photoelectric tube, popularly known to the public as the electric eye, is in many respects the most versatile member of the electron tube family. A complete listing of the applications of photoelectric devices would more than fill this page. They count objects passing on a conveyor belt, they inspect bottled beverages and reject those containing foreign particles, they turn on lights in buildings and at airfields when the natural illumination falls below a predetermined level, they perform color matching operations in paint and textile factories, they judge the temperature of heated metals by the color, they open garage doors when an automobile approaches, they inspect and sort objects according to size, shape, or color, and they sound alarms in cases of smoke or fire.

In spite of its manifold and varied applications, the phototube is comparatively simple in structure. In its usual form (Fig. 3), it consists of a semi-cylindrical cathode coated with a photosensitive material, and a straight wire anode. These elements are enclosed in an evacuated or a gas-filled glass envelope. The straight wire anode is used because it offers little obstruction to light to the cathode.

Caesium, rubidium and barium are examples of photosensitive materials. These materials emit electrons when struck by light. The spectral sensitivity of the phototube—its response to various wavelengths of light—is determined by the nature of the cathode material. By proper choice of materials, the tube may be made most responsive to red or to violet or to any other portion of the light spectrum. Phototubes are available which will respond to ultraviolet or to infrared rays, and in this respect they exceed the performance of the human eye.

Fig. 2. Basic circuit arrangement of photoelectric control. The light falling on the phototube causes flow of current through R_1. The voltage drop across R_1 makes grid of V_1 positive. Increased plate current of V_1 causes the relay in the circuit to close.



"On-Off" Controls

In many of its applications, the phototube serves as a light-operated switch. The basic circuit arrangement of a photoelectric control is shown in Fig. 2. When light strikes the cathode of the phototube, electrons are emitted and attracted by the positive potential of the anode. The resulting current flow produces a voltage drop across R_1 which makes the grid of V_1 positive. The increased plate current of V_1 causes the relay to close. The relay contacts then operate a light, bell, alarm, motor, or other device.

If the voltage drop across R_1 is applied as bias to the cathode of V_1, the relay will close when the light beam is interrupted. In addition, the relay may have normally-open or normally-closed contacts or both, so that circuit operation may be initiated by the presence of light or by its absence.

The circuit shown in Fig. 2 can be used to control the filling of bottles. When the liquid in the bottle reaches a predetermined level, it intercepts a light beam. The relay in the photoelectric control then stops the filling mechanism until the next bottle moves into position. As shown in Fig. 1, photoelectric devices are used to inspect bottled beverages. The presence of any foreign particles changes the amount of light reaching the phototube. The relay then operates a reject mechanism to remove this bottle.

The circuit shown in Fig. 2 will also serve as a smoke or flame detector. The presence of smoke will decrease the amount of light reaching the phototube, and the relay will then sound an alarm. In some installa-

tions, circuit action is initiated when light from the flames reaches the phototube. In a related type of equipment, the phototube "watches" the pilot burner in an oil or gas furnace. If the pilot should become extinguished, the photorelay closes the fuel supply. This prevents unignited fuel from accumulating in the furnace.

Phototubes are often used to safeguard operators of power machinery. If the operator should accidentally get his hand in the machine, a beam of light is interrupted and the photorelay opens the main power circuit.

Elevator leveling is another application of the phototube. If the elevator is not properly aligned with the floor level, the photorelay cuts off the power to the door opening mechanism.

The phototube is widely used for sorting objects according to color. Beans, for instance, passing through a revolving drum are inspected by phototubes. If the bean is white it is passed by the machine, but a dark or discolored bean causes the photorelay to actuate a reject mechanism. One installation of this type sorts 80,000 pounds of beans daily.

Used as a pin-hole detector, phototubes inspect steel strip at a rate of 1000 feet per minute. The presence of a hole in the steel allows light to pass through to a phototube. The photorelay then operates a marking device which marks the location of the defect.

If the relay of Fig. 2 is replaced with an electromechanical counter, the circuit will serve to count objects passing on a conveyor belt. Each object, in passing, interrupts a light beam and causes the numbered discs of the counter to move up one position. Similar arrangements are used to totalize highway traffic or count department store customers.

Fig. 5 shows a commercial photoelectric control. A unit of this type is extremely versatile and can be applied to a wide variety of photocontrol operations.

Loop Control

In many manufacturing processes, a continuous strip of cloth, metal, or other material passes in turn through several machines. If the material does not pass through each machine at the same rate, it may pile up in front of one of the machines or it may be stretched to the point of breakage. Photoelectric controls are used to allow and maintain a predetermined amount of slack in the strip of material. This arrangement is referred to as *loop control* and is illustrated in Fig. 4. Under normal conditions, the strip of material interrupts the light beam to photocontrol number one but not to control number two. If the material passes too rapidly through machine 2, the slack will be taken up and light will reach photocontrol number one. This control will then act to slow down the driving motor of machine 2. If machine 1 tends to speed up, there will be excessive slack in the material, and light to photocontrol number two will be interrupted. This control will then slow down machine 1.

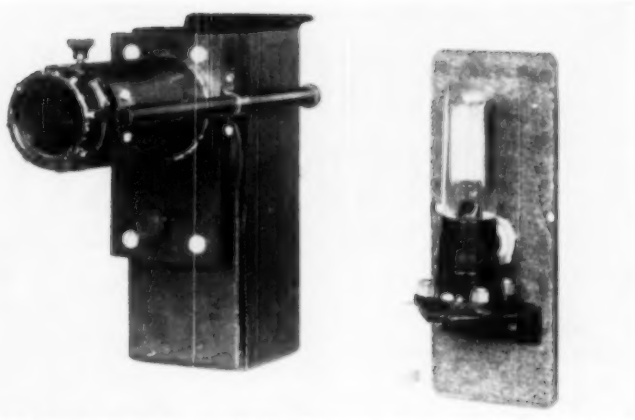


Fig. 3. Phototube holder for photoelectric pyrometer, an instrument which judges the temperature of heated metal by its color. Left view shows lens barrel and sighting tube. Right view shows the unit with the cover removed to expose the phototube.

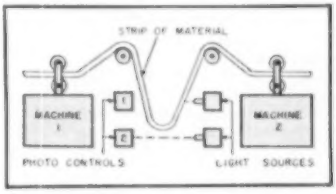


Fig. 4. Loop control prevents strip of cloth, metal, or other material from piling up in front of machine or from being stretched to the point of breaking.

Photoelectric Pyrometer

Because the phototube is sensitive to changes of color, it may be used as a temperature measuring or control device. When used for this purpose, it is referred to as a *photoelectric pyrometer*. In this application, the phototube "looks" through a window into a furnace where metal is being treated. As the temperature of the metal increases, its color changes through the various shades of red to white heat. The phototube, detecting these changes of color, operates a meter which may be calibrated directly in degrees of temperature. In other cases, the output of the phototube may be used to control the heating mechanism and to maintain a constant temperature.

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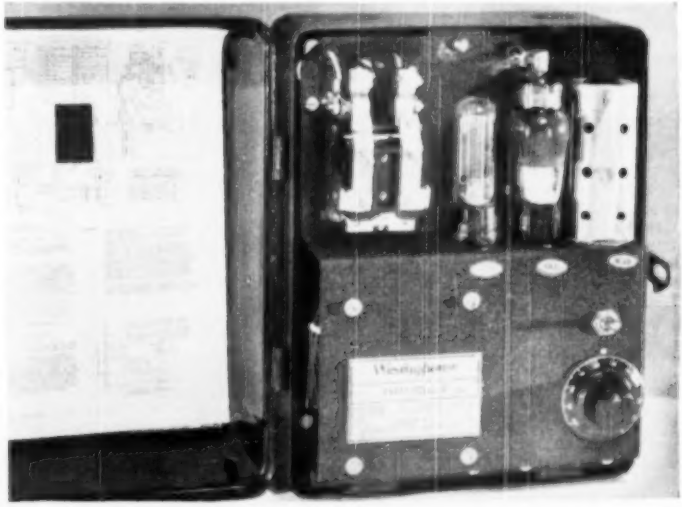
Fig. 5. Photoelectric control unit. The opened cover reveals the relay, phototube, and amplifier. In operation the light enters through the hole in cover of unit.



A SINGLE-TUBE ELECTRONIC KEY

By
DONOVAN V. GEPPERT, W5KFP
Ass't. Professor of Electronics
University of Arkansas

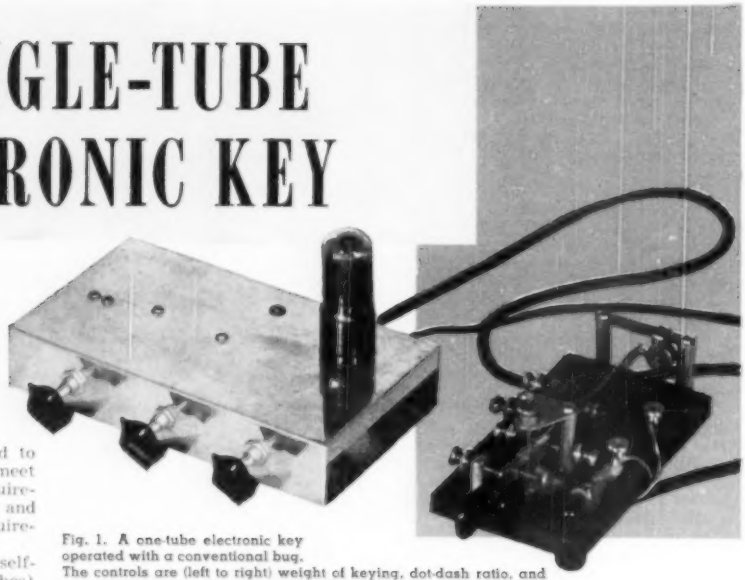


Fig. 1. A one-tube electronic key operated with a conventional bug. The controls are (left to right) weight of keying, dot-dash ratio, and speed. The on-off switch is also actuated by the knob in the center.

Using only one dual-function tube, this new circuit is simple yet comes close to being the ideal key.

THE electronic key, designed to fill present-day needs, must meet certain fundamental requirements as to circuit construction and performance. Among such requirements are:

1. Dots and dashes must be self-completing so that all dots (or dashes) will be the same length, including the last in a series. The key lever must serve only to initiate a dot or dash and not to complete it.

2. The circuit must be such that a dot following a dash (or a dash following a dot) within a letter cannot be initiated until the dash (or dot) *and the following space are both completed.* This feature is essential for effortless keying, since otherwise the operator must not close the key lever on the opposite side *until* the dash (or dot) is completed. This requires an extremely critical sense of timing, and if condition number one is fulfilled, then, by all means, requirement number two must also be met. In addition, release of the key lever in the middle of a dot or dash must not affect the length of that character.

3. The key switching requirements must be simple and adaptable to ordinary mechanical bug technique.

4. A smooth control of speed must be obtainable over a range from about 10 to 40 w.p.m.

5. The ratio of dot length to dash length must be variable to suit the tastes of different operators. Some objection may be raised to this requirement, since the theoretically correct ratio is three to one. However, some deviation from this value may allow easier sending by some operators.

6. The ratio of dot length to space length, the so-called weight of keying, must be variable to suit the tastes of different operators. Again some objection may be raised, since the theoreticaly correct ratio is one to one, but some operators prefer a slightly heavier weight than normal. Those who object to this requirement can always set the ratio at unity and saw off the shaft.

7. The three controls: speed, dot-dash ratio, and weight of keying, must be independent of one another. For example, a change in the speed setting must not change the dot-dash ratio nor the weight of keying.

8. The circuit must be electrically and mechanically stable and rugged. For example, the circuit must be operative from a power source having poor voltage regulation. Variations in tube characteristics must not affect the operation. The circuit must be reliable and foolproof and not require any critical adjustments on the part of the operator.

9. The circuit must be simple, use a minimum number of inexpensive components, and be conducive to compactness of construction and economy in construction and operation. All parts used in its construction must be readily available.

Considering all of the stringent requirements, it is not surprising that electronic keys have not been developed to the point where they are considered as a necessary adjunct to the average ham station. However, the history of electronic keys has been one of considerable progress, which means that more and more of the requirements listed have been met. The circuit to be described herein represents, in the author's opinion, one of the closest approaches yet made to the ideal electronic key.

The circuit requires only one tube, as shown in Fig. 2. A 117L7GT tube performs the dual function of half-wave rectifier and relay tube. The screen is tied to the plate, thus making a triode out of the beam tetrode section. A voltage divider, consisting of R_1 and R_2, normally biases the tube beyond cut-off, so that the relays RL_1 and RL_2 in the plate circuit are normally de-energized.

When the circuit is first put into operation, both C_1 and C_2 charge to the full plate supply voltage (about 140 volts). When the key lever is thrown to the dot side, two things begin to happen. Condenser C_2 discharges very quickly through the very low resistance R_3. Simultaneously, the grid of the tube is driven positive by virtue of the voltage dividing action of R_1 and R_2 plus R_3. (R_3 is negligible as far as the grid voltage is concerned.) As the grid is driven positive, the plate current quickly rises to a high value, energizing relays RL_1 and RL_2. Energizing RL_2 opens the discharge path for C_2, thus permitting it to recharge to the plate supply voltage. The charging current flows through R_4 and R_3, thus maintaining the grid voltage at a value sufficient to keep the relays energized after RL_2 has opened the discharge path and removed "B+" from the voltage divider in the grid circuit. As C_2 approaches full charge, the charging current approaches zero, the grid voltage becomes more negative, and the plate current approaches zero. Eventually relay RL_2 becomes de-energized, thus re-closing the discharge path. If the key lever is still closed when RL_2 be-

comes de-energized, the cycle repeats itself.

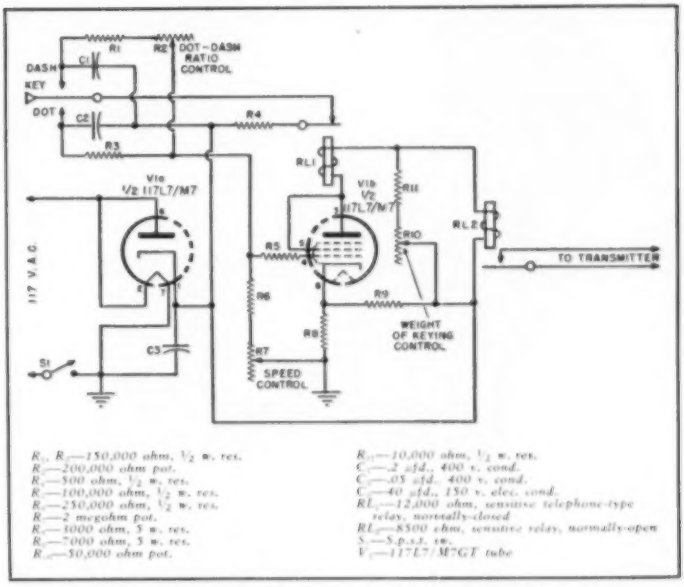
Relay RL_2 is shunted by resistors R_{10} and R_{11} so that it becomes de-energized at a higher value of current than RL_1. Proper adjustment of R_{10} makes RL_2 open at any time during the charging period of C_3, thus allowing the weight of keying to be varied at will.

If the key lever is closed on the dash side the action is similar, except that a longer time is required to charge C_1 due to its higher capacitance. The purpose of resistors R_1 and R_2 is to prevent, as far as possible, any interaction between the voltages on C_1 and C_2. Complete isolation is impossible, of course, with the result that the dot-dash ratio is not entirely independent of the setting of the speed control R_8. As R_7 is varied, the discharge time for both C_1 and C_2 is varied, but at the slower speeds (higher values of R_7) greater interaction occurs between C_1 and C_2, resulting in a slight reduction in dash-to-dot ratio. The interaction could be completely eliminated by using entirely independent charging paths for C_1 and C_2, but this would require a ganged potentiometer for speed control as well as an additional tube. Variation in R_7 changes the charging time for C_3 thus varying the dash-dot ratio. The purpose of R_4 is to prevent excessive grid current being drawn by the tube and upsetting the charging characteristics of C_1 and C_2.

The circuit shown meets requirements 1, 2, 3, 4, 5, 6, 8, and 9 very satisfactorily. The only requirement which leaves anything to be desired is number 7, which states that the three controls; speed, dot-dash ratio, and weight of keying, must be independent. The speed and dot-dash ratio are independent of the weight of keying control, but the dot-dash ratio and weight of keying vary slightly with a change in speed. However, if the speed is not varied over a ratio greater than about 2½ to 1, the change in dot-dash ratio and weight of keying is small. This encompasses the normal range of about 12 to 30 w.p.m., so that only when changing from a very low to a very high speed, or vice versa, will any readjustment of the other two controls be necessary.

The circuit shown is very insensitive to changes in plate supply voltage. For example, a variation from 90 volts to 300 volts affects the operation of the circuit only slightly.

Fig. 1 is a photograph of a unit built using the circuit diagram of Fig. 2. All of the components except the tube are mounted beneath the chassis. The line switch and the dot-dash ratio control are on the same shaft. In order to avoid the necessity of building a lever system, an ordinary mechanical bug was modified to serve the purpose. This has the additional advantage of permitting the key to be placed in the regular operating position and the controls placed in the most convenient position



R_1, R_2—150,000 ohm, ½ w. res.
R_3—200,000 ohm pot.
R_4—500 ohm, ½ w. res.
R_5—100,000 ohm, ½ w. res.
R_6—250,000 ohm, ½ w. res.
R_7—2 megohm pot.
R_8—1000 ohm, 5 w. res.
R_9—7000 ohm, 5 w. res.
R_{10}—50,000 ohm pot.
R_{11}—10,000 ohm, ½ w. res.
C_1—2 μfd., 400 v. cond.
C_2—.05 μfd., 400 v. cond.
C_3—40 μfd., 150 v. elec. cond.
RL_1—12,000 ohm, sensitive telephone-type relay, normally-closed
RL_2—8300 ohm, sensitive relay, normally-open
S_1—S.p.s.t. sw.
V_1—117L7/M7GT tube

Fig. 2. Complete schematic diagram for building the electronic keying unit.

for adjustment with the other hand. The only modification necessary was removal of the weight from the vibrator, adjustment of the dot contacts to provide positive closure without vibration, and removal of the connection between the dot and dash contacts. A three-conductor cable connects the key to the chassis. The only disadvantage to this arrangement is that the key is at line potential and represents a hazard to the operator. Enclosure of the key is recommended in order to eliminate this hazard.

The large relay, shown in Fig. 3, is a telephone-type which is available on the surplus market for less than a dollar. This unit, RL_1 on the diagram, should be duplicated for best results. The coil resistance of this relay is 12,000 ohms and closes at 3½ ma. and opens at 2 ma. The small relay RL_2, is a sensitive 8500 ohm unit. This relay is not critical and other units having approximately the small coil resistance and sensitivity could have been used. The closing current should be no greater than about 3 or 4 ma. A d.p.s.t. relay, used for RL_2, would permit keying a monitoring oscillator simultaneously with the transmitter.

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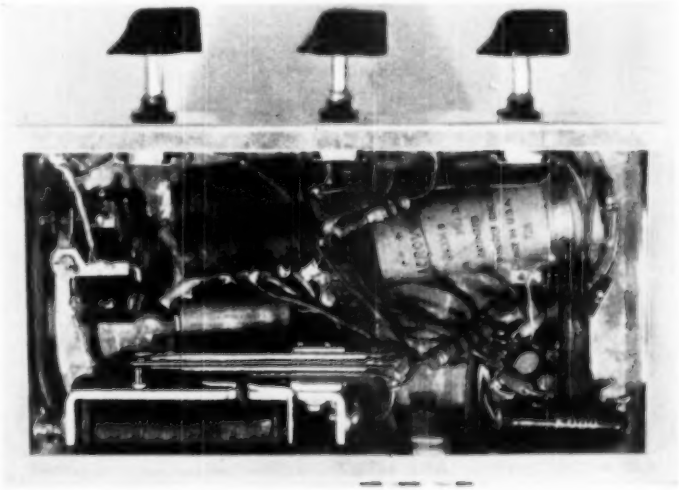
Fig. 3. Placement of parts is not critical as this under-chassis view shows.



ADD A NOISE LOCALIZER CIRCUIT To Your Signal Tracer

Noise localizer being used to locate source of noise in a.c.-d.c. receiver. The d.c. selector switch is in "150-volt" position to prevent damage to low voltage components. "Hot" lead of test probe is connected to top of standard insulated prod held by technician. Lead shown clipped to receiver has other end connected to shielded cable of test leads. A signal tracer probe can be seen at right of unit's cabinet.

By
WILLIAM A. TRETTER
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Temple University

All components—resistors, coils, tubes, etc.—can be checked without removing them from the circuit.

THE addition of a few components to the input circuit of the signal tracer will make it a more versatile instrument. Of the number of additional uses to which it can be put, two important ones are: It will localize the source of noise in a "cold" set; secondly, it can also be used as a very high resistance ohmmeter.

Some of the checks include locating noisy and microphonic tubes, noisy variable and fixed condensers, noisy coils and transformers, noisy variable and fixed resistors, and noise caused by leakage across tube sockets and terminal boards, etc. All of the above listed tests are made with no power applied to the receiver under test.

A study of the circuit shown in Fig. 1 shows how the input circuit of the signal tracer is wired to accommodate the additional components. A three position switch selects the proper voltage for either a.c. receivers or a.c./d.c. sets. In the "off" position the signal tracer is used for its normal functions. The 150 volt tap is used when checking receivers employing only 150 volt components. The zero to one milliammeter is optional since plug-in jacks can be used to accommodate the shop instrument thus saving the cost of another meter.

The test lead is merely a short length of shielded cable with the outer shield grounded to the chassis of the signal tracer. When making checks with the noise localizer, this test lead is substituted for the standard signal tracer probe that usually incorporates a fixed germanium crystal.

After the circuit additions have been made, apply power to the signal tracer. As soon as plate voltage is present the meter will deflect to full scale and then immediately drop back to zero after the input condenser is fully charged. Shorting the test leads will cause the meter to read full scale or one milliampere, and at the same instant a very loud "click" will be heard in the loudspeaker of the signal tracer. This loud "click" is caused by the sudden discharge of the input condenser. When the leads are again separated, another click will be heard as this condenser again begins to charge.

What makes this method so effective is the fact that normal voltage is applied to the circuit under investigation and current flows if the circuit has continuity. Should any momentary open, short, or arc-over occur, it will be heard in the loudspeaker as a loud crackle or hiss.

The service technician should be familiar with normal leakage found in all types of condensers. Mica condensers have leakage so small that it can barely be detected with the average ohmmeter. With this method, however, it is possible to detect the slightest amount of leakage present in all high gain amplifier and television circuits.

After the standard signal tracer probe has failed to locate the source of noise, the receiver is turned off and the power plug disconnected. The selector switch on the signal tracer is then set to the proper voltage tap, depending on whether the receiver is a.c./d.c. or an a.c. set employing a power transformer. Connect the outer shield or clip lead to the "B plus" terminal in the set. The probe is then momentarily connected to the plates and screen grids of the tubes. If a loud clean click is heard at each instant of contact, the circuit has continuity. The meter will be a more definite indication of this and at the same time will measure any resistance present. Circuit components should be tapped and "jiggled" before

moving the probe to the next check point.

If, while checking one of the described circuits, a crackling or hissing sound is heard in the loudspeaker, it indicates that one of the parts is defective. Leave the clip lead connected and move the probe along the circuit towards this clip lead. As the probe is moved across solder joints, dropping resistors, and other circuit components, the noise may get louder and at some point may disappear completely. This indicates that the noisy component is no longer between the two test leads. The procedure now is to move the probe back to the last point where the noise was heard, and then move the clip lead towards the probe. The disturbance will be loudest when the noisy component is directly between the two test leads. Regardless of whether it is a defective resistor, coil, or poor contact, it will create a terrific noise in the signal tracer loudspeaker.

This same procedure is followed when checking grid and cathode circuits. The clip lead is left connected to the receiver chassis or "B minus," while the other probe is momentarily connected to the grids, cathodes, and other elements that normally return to "B minus." Should a noisy component be present in the circuit, move one test lead along the circuit towards the other until the disturbance is loudest.

Checks for microphonic and noisy tubes are made with the tubes "cold." The test leads are connected across two adjacent elements at the base pins and the tube is gently tapped. Even "good" tubes may show up as slightly microphonic under this test. If several good tubes are compared with one that is known to be noisy, the difference can be noted and used for future reference. Since the tubes are "cold" in the set they cannot amplify the noise and transmit it to other stages.

An inspection of the noise localizer circuit will show that at no time can more than one mil of current flow between the test leads so there is no danger of excessive current through a circuit under test. The only precaution that need be taken is to discharge all large condensers after connecting the test probes. The d.c. voltage selector switch must be in the "off" position when tracing a signal through the set with the signal tracer probe, otherwise damage to the crystal may result. The input condenser in Fig. 1 must be wired into the circuit if the signal tracer input does not have one. Any value around .01 μfd. mica rated at 600 volts will do.

Noisy tuning condensers, whether caused by poor rotor contact or by intermittent shorts between rotor and stator, can be located easily. An intermittent short also shows up as a small arc as the tuning condenser is rotated, whereas a noisy rotor will result in a scraping sound in the loudspeaker.

Arc-over inside a broken carbon or wirewound resistor is usually a difficult fault to track down with an ordinary ohmmeter or the signal tracer diode probe. The ohmmeter fails because of the low voltage employed, and the signal tracer will detect noise at several points in the receiver. The noise localizer will find the trouble in nine out of ten cases where other methods fail.

Transformers and coils are tested by using the same procedure described earlier. Intermittent shorts and arc-over will be audible as a loud hiss or crackling in the signal tracer speaker. Noisy multiband, phono, and tone selector switches can be checked in the same manner. Dirt and corrosion can cause noise in any of the circuits connected to the selector switches. Here, too, poor contact will show up as a "hiss" or crackling in the loudspeaker.

Should any feedback or motorboating occur when the volume is turned up full, it can be eliminated by adding two .5 μfd. condensers between the 150 volt tap, the 250 volt tap, and ground. But it will seldom be necessary to operate the noise localizer at full volume.

The variable resistor, shown as the "zero adjust" in Fig. 1, may be required to compensate for variations in power supply voltages. It is adjusted for one milliampere or full scale deflection after the warm-up period. If the supply voltage maximum is around 150 volts, the 125,000 ohm resistor is not required. The lower voltage will reduce the high resistance range of the ohmmeter somewhat.

An instrument of this type is not intended to replace the regular signal tracing techniques. Rather it is an adjunct to aid in the difficult cases which

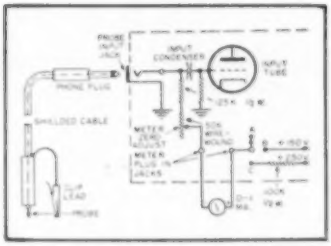

Fig. 1. Wiring diagram of the input circuit found in the average signal tracer and the additional components required when the noise localizer is incorporated. When the selector switch is in position "B" or "C" the noise localizer circuit is turned on. The cable shown is substituted for the standard signal tracer probe when the noise localizer circuit is in operation.

can not be located by conventional means.

It is essential that the parts used in the localizer be of good quality to prevent erroneous conclusions caused by noisy parts in the instrument itself. It would be rather foolish to add to the existing receiver faults.

If it is desired, the meter scale may be calibrated to read directly in ohms, increasing the versatility of the instrument. If a 250 volt plate supply is available, a maximum range of five megohms may be obtained. Resistors of known value may be used for calibration.

The small cost of the parts needed to add the noise localizer is a good investment and will pay high dividends in time saved. Wear on other equipment is also reduced since now a signal tracer, ohmmeter, and noise localizer are incorporated into one unit.

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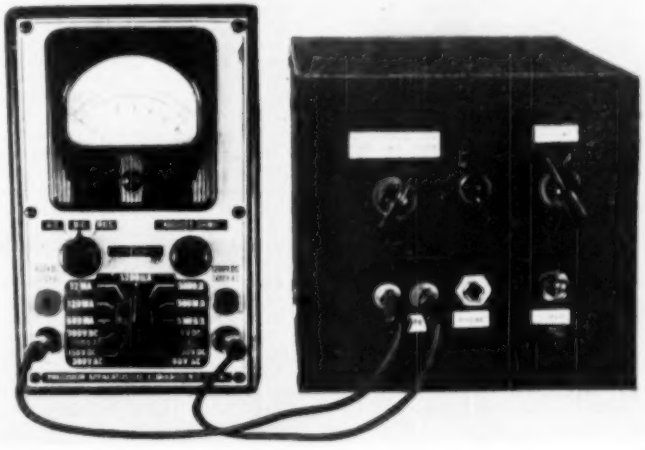
Over-all view of the noise localizer. All parts are mounted inside of the cabinet. Holes are drilled along the top and bottom of the rear panel to provide the required ventilation. The circuit used is similar to the one described in the October 1949 issue of RADIO & TELEVISION NEWS in the article "A Signal Tracer at Minimum Cost." The only changes are the addition of the noise localizer circuit and substitution of a 6SN7GT for the two 6J5 tubes.



DUAL-INPUT TAPE RECORDER AMPLIFIER

By
GLEN SOUTHWORTH

Over-all view of the auxiliary input unit used in conjunction with tape recorder.

Features high gain inputs, equalizer for 7.5" tape speed and outputs for monitoring and volume meter.

ALTHOUGH in general use for only a few years, tape recording is rapidly supplanting nearly every other type of high quality recording media, even the popular phonograph record often being a copy of a tape master recording. Even after a comparatively short period of development, tape represents the highest quality recording technique known, with machines having a range of sixty decibels, low distortion, and excellent frequency response to above fifteen thousand cycles being available from a number of manufacturers.

The comparatively excellent quality and low operating cost of relatively inexpensive tape mechanisms have led manufacturers to offer a number of low cost tape machines to the public. The purchaser who wishes to use one of these machines for high quality recording and playback is usually faced with several limitations brought about by the necessity for economy in the design of the machine. The first of these is usually an inadequate power output stage and loudspeaker, making an additional power amplifier and speaker system desirable. When this adjustment is made two other factors may become noticeable: an unpleasantly high noise level, usually hum, and deficiencies in frequency response at both very high and low frequencies, both of which are not too noticeable when limited range equipment is used. Noise may originate in two places, in the amplifier system, where the conventional procedures of decoupling, shielding, elimination of ground loops, etc., may be used, or due to electromagnetic coupling between the motor or power transformer and the tape playback head, hum may be introduced at this point and may often be reduced by the use of soft iron as magnetic shielding.

Several other drawbacks that might be mentioned are the usual absence of provision for mixing the inputs from more than one microphone and the lack of adequate monitoring and volume level indicator facilities. In many recorders the only level indicator is of the neon bulb type which is often difficult to interpret and may suffer from a tendency to drift, with consequent over or under recording.

The experimenter who has obtained one of the several inexpensive tape machines now on the market may find it convenient to construct an auxiliary input system such as the unit shown in the accompanying schematic and photograph. This amplifier includes two high gain inputs, separately controlled, an equalizer for the 7.5 inch tape speed, and a separate output stage for monitoring and v.u. meter. Intended primarily to extend the range and usefulness of a conventional tape machine, it should likewise make an excellent unit for the reader who wishes to assemble his own complete system for use with a high quality amplifier speaker combination.

Several features are incorporated in this amplifier design that are worthy of note. One in particular is the use of 100,000 ohm volume controls in the mixer stage. This can be very important from the standpoint of maintaining uniform high frequency response at all settings of the control. Due to the input capacity of the tube as well as stray capacity to ground, the conventional five hundred thousand ohm pot may act as a low-pass filter at mid-setting where there is a resistance of 250,000 ohms in series with the grid of the following tube. In the circuit shown, this resulted in more than ten db. attenuation at ten thousand cycles even though very short leads and no shielding were used. Use of lower impedance controls tends to minimize this effect although larger coupling condensers must be used to prevent low frequency attenuation.

It will be noted that the two plates of the 6SL7 mixer tube are isolated from each other by 100,000 ohm resistors rather than tied together as is often the practice. This is done to prevent serious intermodulation distortion which may be caused when both channels are used simultaneously, as it reduces the effect of the plate circuit of one half of the tube, acting as a widely varying load upon the other one.

The equalizer circuit (R_{15}, C_8, R_{16}, C_7 and S_1) produces ten decibels boost at fifty cycles and approximately nine db. boost at ten thousand c.p.s., with the point of minimum boost being between fifteen hundred and two thousand cycles, thereby closely matching the characteristics needed for a tape speed of seven and one half inches. When used during both record and playback cycles, this gives an equivalent equalization of approximately twenty decibels at both ends of the audio range. If a constant current recording characteristic is used with a recording head such as the *Shure* TR5, this amount of equalization should give over-all response flat within a few decibels from fifty to ten thousand c.p.s. at the 7.5 inch tape speed.

Inasmuch as the system may be required to amplify input signals as low as a few hundred microvolts, it is necessary to reduce the noise level in the amplifier as much as possible. It will be noticed that a potentiometer with

the center tap grounded is placed across the filament supply. This is often useful in minimizing hum pick-up when a high impedance input, such as a crystal microphone, is used, and should be adjusted for minimum hum under these conditions. Likewise, it is desirable to use a separate ground system such as shown in the schematic, as this is often of considerable importance, particularly around the input stage where it is usually desirable to isolate the input jack from the chassis. By following these practices the hum level of the unit built by the author was very low, even though a.c. was used on all filaments. Resistance-capacitance filtering was used in the circuit in order to prevent possible coupling between the magnetic field of the power transformer and a choke, with resultant induced hum.

A ninety mil power transformer was used in the amplifier constructed by the author in order to have available power for an external bias oscillator or audio power stage, however for the circuit shown this could easily be reduced to forty mils. Due to the relatively light loading of the power supply by the voltage amplifier stages alone, care should be taken that the voltage at the cathode of the rectifier does not exceed a safe value with regard to the filter condenser at this point.

In operation the auxiliary amplifier is intended to be used to drive the stage of a conventional recorder which drives the recording head. This can usually be done with a minimum of rewiring or circuit alteration. A closed circuit jack installed on the recorder chassis makes a very convenient arrangement as the recorder may then be used either with its self-contained amplifier or, by plugging in, with the external amplifier system. If desired, the output stage of the auxiliary amplifier may be used to directly drive a high impedance recording head, such as the *Shure* TR5 dual track or *Indiana Steel* single track, through a suitable series resistance. When used in conjunction with a bias oscillator tape transport mechanism, and high quality amplifier for playback, this arrangement should be well suited for those who wish to assemble their own systems. If desired, more than two input channels can be incorporated, and the design may be modified easily to provide two entirely separate channels for dual track binaural recording or the simultaneous reproduction of two separate programs.

As the ultimate quality of the reproduction will depend to a great extent upon the original input signal, the choice of a microphone is of considerable importance. For some reason or another, little is said about the advantages of crystal microphones other than that they are inexpensive and possess a relatively high output level. Due to the fact that dynamic or ribbon microphones are almost invariably used in broadcast work, the misconception that these types have inherently superior fidelity has gained ground. The widespread use of magnetic microphones can be traced largely to a number of other factors. One of the most important is the fact that they are low impedance devices that can be used with long cables and complicated switching and mixing arrangements without fear of hum pick-up. With regard to actual fidelity, the magnetic microphone is subject to a number of serious distortions, particularly nonlinearity and poor transient response (especially in the case of ribbon microphones) as well as a number of other factors. These distortions are sometimes considered valuable by the broadcast engineer for reasons that will be noted later.

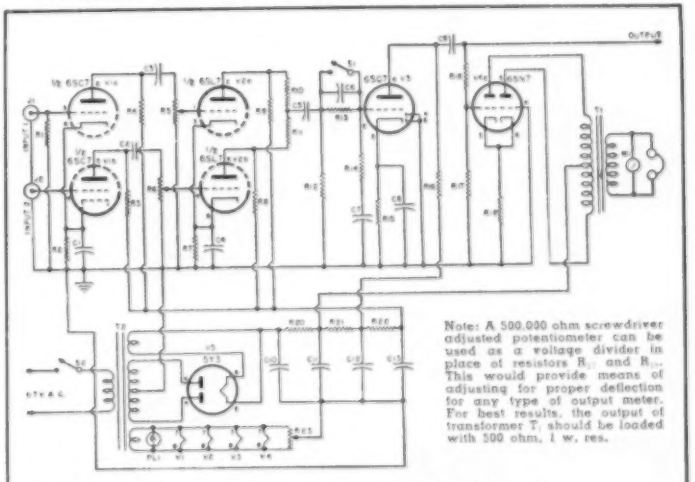
The crystal microphone is a sensitive, highly damped, pressure operated transducer capable of remarkably good linearity over a very wide dynamic range as well as excellent transient response. Similarly, excellent units may be purchased with good frequency response from below thirty c.p.s. to above ten kilocycles. While these qualities imply superior fidelity, they bring up several interesting problems in reproduction. Most important of these is the fact that the associated equipment used to translate the electrical output of the microphone back into acoustic energy may have defects or limitations that are accentuated by the wide range input.

An example of the foregoing that is of considerable importance in broadcast and other work where a maximum output level must be obtained whenever practical, is the relationship between the peak amplitudes and the average power contained in such complex sounds as speech or music. This relationship is usually determined by the type and complexity of the original sound and the fidelity of the microphone and associated equipment. With conventional broadcast equipment this ratio is approximately ten decibels, meaning that to obtain an average output of one watt an amplifier with undistorted sine wave capabilities of ten watts must be used. Limited frequency response, nonlinearity, and poor transient response all tend to lower this ratio. On the other hand, the author's experiments with crystal microphones have indicated that due to superior transient and complex wave characteristics, a ratio of peak-to-average power of fifteen or twenty decibels may be required for undistorted reproduction. These results tend to approximate some of those found by experimenters in the new, ultra-wide range, miniature condenser microphones.

The implications of the differences between peak and average power ratios are of considerable importance. Assuming an increase of six db. in the ratio by the use of accurate wide range mike pickup, this will mean

(*Continued on page* 114)

Schematic of audio amplifier. It will drive any high impedance recording head.



Note: A 500,000 ohm screwdriver adjusted potentiometer can be used as a voltage divider in place of resistors R_{31} and R_{32}. This would provide means of adjusting for proper deflection for any type of output meter. For best results, the output of transformer T_1 should be loaded with 500 ohm, 1 w. res.

R_1, R_{13}—5 megohm, ½ w. res.
R_2, R_4, R_{14}, R_{16}—1500 ohm, ½ w. res.
R_3, R_{15}, R_{17}, R_{20}, R_{23}, R_{25}—100,000 ohm, ½ w. res.
R_5, R_{27}—100,000 ohm pot.
R_6, R_{28}—500,000 ohm, ½ w. res.
R_{11}, R_{12}—50,000 ohm, ½ w. res.
R_{30}—2500 ohm, 10 w. res.
R_{31}—5000 ohm, 2 w. res.
R_{32}—25,000 ohm, ½ w. res.
R_{33}—40 ohm wirewound pot.
C_1—100 μfd., 25 v. elec. cond.
C_2, C_3, C_{10}—1 μfd., 400 v. cond.
C_4—25 μfd., 25 v. elec. cond.
C_5—.05 μfd., 400 v. cond.
C_6—.0001 μfd., 400 v. cond.
C_7—.002 μfd., 400 v. cond.
C_8—.05 μfd., 400 v. cond.
C_{26}, C_{27}, C_{28}—10 μfd., 450 v. elec. cond.
M_1—V.u. meter
S_1, S_2—S.p.s.t. sw.
$P1_1$—6.3 v. pilot light
T_1—Output trans., 20,000 ohm pri. to 500 ohm sec.
T_2—Power trans., 300-0-300 v. @ 40 ma.; 5 v. @ 2 amps; 6.3 v. @ 2 amps.
V_1—6SC7 tube
V_2—6SL7 tube
V_3—6SQ7 tube
V_4—6SN7 tube
V_5—5Y3 tube

DESIGN DATA On High IMPEDANCE PROBES

Oscilloscope probe. The resistor and condenser shown at left are mounted inside probe housing.

By
R. G. MIDDLETON

Practical theory of probe design—points covered apply to all circuits where high impedance and frequency compensation are major requirements.

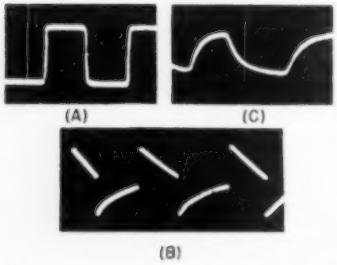
OSCILLOSCOPES are much more useful when provided with high-impedance probes, since waveforms may then be observed in critical circuits and high-impedance circuits without serious disturbance of circuit function. Practical theory of probe design is explained in this article, so that a probe may be designed for any requirement.

Besides offering a high impedance to source voltages, an oscilloscope probe has the important property of frequency compensation. Practically, this means that when a square wave is tested with the probe, the screen pattern will appear as in Fig. 1A with faithful reproduction, and not as Figs. 1B and 1C.

Square waves from a suitable multivibrator are particularly convenient for adjusting scope probes; this is because a square wave actually is built up of multitudes of harmonic frequencies.

What has happened in the case of

Fig. 1



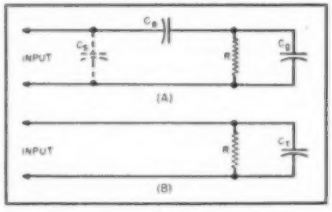


Fig. 2

Figs. 1B and 1C? Nothing but frequency distortion; the input network to the scope has discriminated against low frequencies in the first case, and against high frequencies in the second, but with a properly designed probe, both waveforms may be restored to the shape of 1A over the useful range of the scope.

The square-wave method of testing is used to trim up the input circuit of a scope by adjusting for a 100-cycle square wave and then checking response on a 10,000-cycle square wave.

Design factors involved are indicated in Fig. 2. The input terminals of the scope work into a circuit composed of resistance and capacitance in shunt. The blocking capacitance shown in Fig. 2A is to be neglected, since it is effectively a short circuit at the frequencies of interest. The stray wiring capacitance C_s may be combined with the tube input capacitance C_g to form the equivalent circuit of Fig. 2B.

The resistance, R, is the value of the grid leak, and may be slightly lower if leakage exists between input terminals, socket springs, wire insulation and ground, or blocking condenser and ground. This effective shunt resistance may be represented by R.

Now this is evidently an input circuit which is not frequency-independent. At very high frequencies, the effective shunt capacitance C_T forms a bypass to ground which impairs the quality of waveform indication on the screen of the scope, as well as detuning and loading the resonant, high-impedance circuits being tested.

This drawback is easily overcome in scope design by using an RC probe like that shown in Fig. 3, the electrical characteristics of which compensate for the deficiencies of the input circuit. As will be demonstrated, the series resistance R_1 and series capacitance C_1 of the probe exhibit a frequency characteristic which can exactly correct the deficiencies of R_2 and C_2, the shunt parameters of the

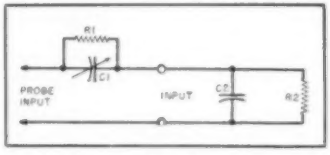


Fig. 3

circuit. Moreover, choice of suitable values of probe resistance and capacitance transforms the input impedance (absolute value) to a magnitude ten times as great as that encountered in typical practice. It can be shown that when $R_1C_1 = R_2C_2$, the input circuit becomes independent of frequency; in practice, this is verified by applying a square wave to the probe at several fundamental frequencies and

(*Continued on page* 137)

BANDSWITCHING SUPERHET for HAM BANDS

Front and rear views of the home-built superhet.

By
R. W. JONES, W6EDG

Basically, a tuner for the 3.4-4.2 mc. band with a companion converter covering 7, 14, 27, and 28 mc. bands.

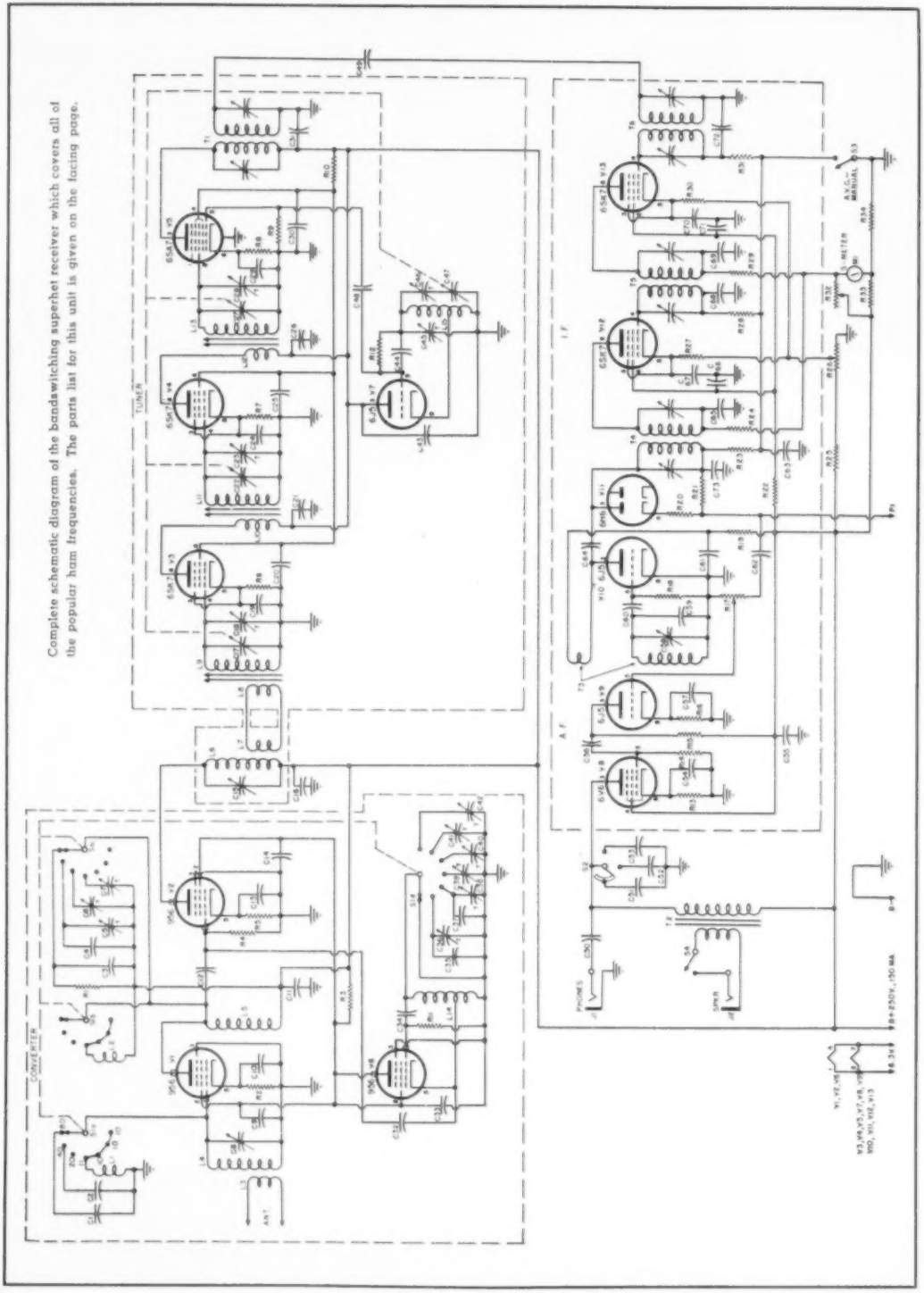
THE usual receiver described for the amateur or experimenter who prefers to "roll his own" resorts to plug-in coils, regenerative i.f. and r.f. stages and is generally not equipped with the refinements of even the cheapest factory-built job. This article will describe a bandswitching superhet of unique design for the amateur bands. This receiver has good selectivity, good sensitivity, excellent reset value on the tuning controls, and dual conversion for better image rejection on the higher frequency bands. This receiver is built in units, each unit is complete and may be replaced or modified without disturbing other units of the receiver. It is not intended that anyone will use this article for building a "Chinese Copy" of this receiver. It is felt that any amateur or experimenter that undertakes building a superhet receiver of this size will have many ideas of his own. This article, while detailed, will be more a description of the circuits and ideas used and notes on the development of this receiver. The receiver described in this article is the result of several years of construction and use of home-built superheterodynes.

The first model was a conventional type receiver with two r.f. stages, two i.f. stages at 456 kc. and plug-in coils. This receiver was designed for general coverage with a bandspread tuning condenser for the ham bands. A few years' use of this receiver brought out its faults and the final model, the receiver described in this article, evolved from use of this conventional type receiver.

The first drawback of the earlier models was the plug-in coils. To cover all the ham bands and general coverage required 16 plug-in coils. Naturally the plug-in coil needed was always missing and at the bottom of a drawer. Plug-in coils are 1932 equipment, no one wants to spend time and money building a receiver and then have to change plug-in coils.

The original receiver was built for general coverage with a small percentage of overlap on each band. After some use of the receiver it was noticed that it was never used on any frequencies but the ham bands so the general coverage feature could have been eliminated. With the system of general coverage and separate bandspread condensers there was poor reset value on the tuning controls which made schedule keeping and frequency spotting difficult. With the conventional 456 kc. i.f. the image rejection on ten and eleven meters was very poor. The frequency stability was also poor on ten and eleven meters, being especially noticeable on c.w. signals. As could be expected with 456 kc. i.f. the selectivity of the original model was not very good. The earlier models were built on a steel chassis as one unit, which made servicing and modifications difficult.

The receiver described in this article is basically a tuner operating in the frequency range of 3.4 to 4.2 mc. with a converter (fixed tuned) ahead of it for converting 7, 14, 27, and 28 mc. signals into signals falling in the range of 3.4 to 4.2 mc. The i.f. system following the 3.4 to 4.2 mc. tuner is on 175 kc. with the first set of transformers at critical coupling, *a la* Q-5'er, for good selectivity. The block diagram shows the units and their functions. On the block diagram is also shown the fixed tuned converter oscillator frequencies. In all cases the difference frequency is used, and for all bands the oscillator—in the fixed tuned converter—is lower than the received signals frequency with the exception of 7 mc. Note from the tuning chart that the tuning for the 7 mc. band is the reverse of the others. To demonstrate the action of the fixed tuned converter a received signal frequency of 14,000 kc. will be taken as an example. With the 14,000 kc. signal mixed with 10,450 kc., the output of the mixer will be the sum and difference of the two signals. Since the output of the 956 mixer is tuned to the 3.4 to 4.2 mc. range the sum signal will not be present. The difference frequency will be 3550 kc., when the 3.4 to 4.2 mc. tuner is tuned to 3550 kc. the 14,000 kc. will be heard. A received signal at the other end of the 14 mc.

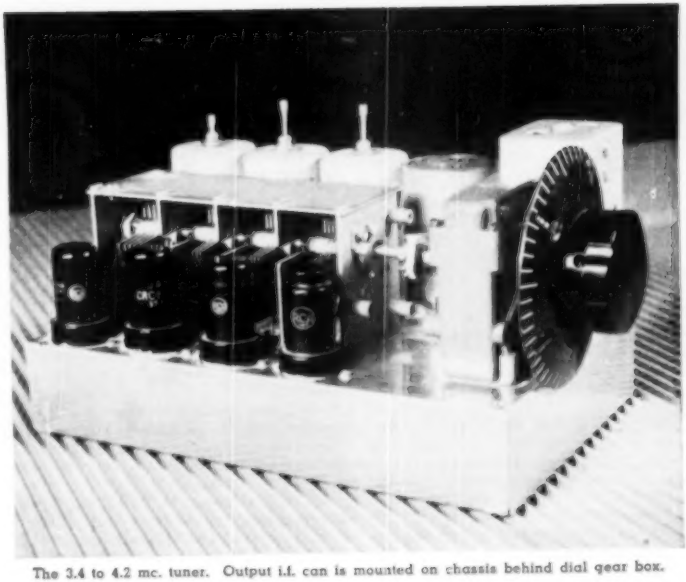


Complete schematic diagram of the bandswitching superhet receiver which covers all of the popular ham frequencies. The parts list for this unit is given on the facing page.

band, 14,400 kc. for instance, would provide a difference of 3950 kc. The 14,400 kc. signal would be audible when the tuner is set to 3950 kc. This same theory applies to all bands except 80 meters; the frequency of the heterodyned signal at the input of the 3.4 to 4.2 mc. tuner being equal to the difference between the original received signal frequency and the fixed tuned converter oscillator frequency. On 7, 14, 27, and 28 mc. the fixed tuned converter is used as a converter but for the 3.5 to 4.0 mc. amateur band it is used as an r.f. amplifier with the converter oscillator disabled. Several systems of mechanical switching were tried for connecting the antenna to the 3.4 to 4.2 mc. tuner when tuning the 80 meter amateur band but were found impractical due to capacity in the switch which allowed 80 meter signals to get into the tuner when using the receiver on other bands. Since the tuning range of the tuner is only from 3.4 to 4.2 mc. only about 700 kc. can be covered on each band setting. This requires three separate band settings for the entire ten meter band, but this is not objectionable and allows good bandspread on the other bands. If the receiver tuner were designed for complete coverage of the ten meter band in 500 dial divisions it would make the bandspread much less on the other bands. The ten meter band is divided so that the c.w. portion is one band, the low end of the phone band another, and the high end of the phone portion the third band setting. The tuning chart shows clearly the bands and their relation. Since this type receiver does its tuning for all bands on the same frequency there is a uniform rate of frequency change per dial division on all bands. At the bottom of the tuning chart is given the kc./div. for each section of the tuning range. This is a good feature when someone tells you they are going "up ten kc."

The receiver is built in four separate units; the fixed tuned converter, the 3.4 to 4.2 mc. tuner, the i.f.-a.f. chassis, and the foundation chassis. The foundation unit is a 11" x 17" x 2" steel chassis with power supply connections, panel, "S" meter, and output transformer mounted on it. Some of the controls are mounted on the foundation chassis and others on the individual chassis. The complete schematic diagram shows location of various parts. Building the receiver in units makes for easy servicing and also facilitates the complete change of one section without disturbing any other unit.

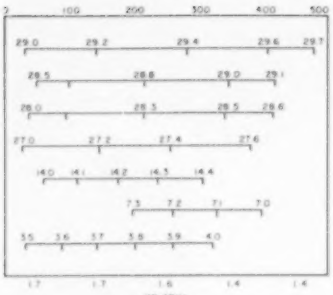
The converter front end uses three 956 acorn tubes. The acorn tube was chosen for two reasons; it is easier to use with this type of construction because its plate and grid leads come out at opposite ends of the tube envelope, and it is cheap on the surplus market. The three tubes used in the converter are all the same type to make replacements easier. The converter has no chassis, the works being built on three uprights of aluminum which are, in turn, held apart by the bandswitch. One acorn tube is mounted on each upright of aluminum; the front tube is the r.f. tube, middle tube the mixer, and the rear tube the fixed tuned oscillator. The two outside uprights of aluminum have feet for mounting on the foundation chassis. The band change switch and the r.f. stage tuning condenser are mounted so that their shafts extend through the front panel when the converter is



The 3.4 to 4.2 mc. tuner. Output i.f. can is mounted on chassis behind dial gear box.

Complete parts list for the bandswitching superhet ham receiver. The circuit diagram appears on the opposite page.

R_1—10,000 ohm, ½ w. res.
R_2, R_3, R—200 ohm, ½ w. res.
R_4—50,000 ohm, 2 w. res.
R_5—150,000 ohm, ½ w. res.
R_6, R_{11}, R_{18}—2000 ohm ½ w. res.
R_7—22,000 ohm, ½ w. res.
R_8—10,000 ohm, 5 w. res.
R_{9a}, R_{10}, R_{12}, R_{13}, R_{15}, R_{16}, R_{17}, R_{19}—100,000 ohm, ½ w. res.
R_{14}—600 ohm, 5 w. res.
R_{20}, R_{24}—220,000 ohm, ½ w. res.
R_{21}—2000 ohm, 2 w. res.
R_{22}—1 megohm pot.
R_{23}, R_{25}—500,000 ohm, ½ w. res.
R_{26}—50,000 ohm, ½ w. res.
R_{27}—50,000 ohm, 5 w. res.
R_{28}, R_{29}—10,000 ohm wirewound pot.
R_{30}, R_{31}—300 ohm, ½ w. res.
R_{32}—4000 ohm, ½ w. res.
C_1, C_2—350 μμfd. mica cond.
C_3, C_{30}, C_{31}, C_{37}—100 μμfd. mica cond.
C_4—80 μμfd. mica cond.
C_5, C_6, C_7, C_{12}, C_{26}, C_{29}, C_{32}, C_{33}, C_{35}—440 μμfd. mica trimmer
C_8—35 μμfd. var. cond. (Hammarlund HF35)
C_{9a}, C_{10a}, C_{11a}, C_{13a}, C_{14a}, C_{15a}, C_{16a}, C_{17a}, C_{18a}, C_{19a}, C_{20a}, C_{21a}, C_{22a}, C_{23a}, C_{24a}, C_{25a}—.006 μfd., 400 v. cond.
C_{27}, C_{28}—50 μμfd. mica cond.
C_{34}, C_{36}, C_{38}—Four-gang tuning cond. (See text)
C_{39}, C_{40}, C_{41}—100 μμfd. (max.) trimmer (Hammarlund APC-100)
C_{9b}, C_{10b}, C_{11b}, C_{13b}, C_{14b}, C_{15b}, C_{16b}, C_{17b}, C_{18b}, C_{19b}, C_{20b}, C_{21b}, C_{22b}, C_{23b}, C_{24b}, C_{25b}—.01 μfd., 400 v. cond.
C_{42}—15 μμfd. mica cond.
C_{43}—500 μμfd. mica cond.
C_{44}—400 μμfd. mica cond.
C_{45}—140 μμfd. (max.) var. cond. (Hammarlund MC140-M)
C_{46}—1000 μμfd. mica trimmer
C_{47}—Insulated hookup wire twisted together (See text)
C_{48a}, C_{49a}, C_{50}, C_{51a}, C_{52a}, C_{53a}, C_{54a}, C_{55a}, C_{56a}, C_{57}—.1 μfd., 400 v. cond.
C_{58}, C_{59}—.006 μfd. mica cond.
C_{60}, C_{61}—10 μfd., 50 v. cond.
C_{62}—15 μμfd. var. cond. (Hammarland HF15)
C_{63}—500 μμfd. mica cond.
C_{64}—200 μμfd. mica cond.
C_{65}—4 t. insulated hookup wire around lead from i.f. can to diode plate
L_1—10 t. #24 en. ⅝" long on Amphenol ¾"x1⅜" form
L_2—10 t. #24 en. ½" long, on Amphenol ¾"x1⅜" form
L_3—7 t. #24 en. ¼" long on Amphenol ¾"x1⅜" form
L_4—15 t. #24 en. ½" long on same form as L_3
L_5—19 t. #24 en. ¾" long on Amphenol ¾"x1⅜" form
L_6—34 t. #24 en. closewound on 1¼" form
L_7—11 t. #24 en. closewound on same form as L_6 closely coupled
L_8—10 t. #24 en. closewound on 1¼" form
L_9—46 t. #24 en. closewound on same form as L_8
L_{10}—10 t. #24 en. closewound on 1¼" form
L_{11}—46 t. #24 en. closewound on same form as L_{10}
L_{12}—10 t. #24 en. closewound on 1¼" form
L_{13}—46 t. #24 en. closewound on same form as L_{12}
L_{14}—8 t. #24 en. ½" long, tapped 1½ t. from gnd. end on Amphenol ¾"x1⅜" form
L_{15}—40 t. #24 en. ⅝" long, on 1¼" form, tapped 4 t. from gnd. end
J—Phone jack
J—Speaker jack
P—Standoff terminal (See text)
M_1—0-1 ma. "S" meter
S_1—S.p. 11-pos. bandswitch (See text)
S_2—Shorting-type, 3-pos. ("Tone Control")
S_3—S.p.s.t. sw. ("AVC-Manual")
S_4—S.p.s.t. toggle sw. ("Speaker")
T_1, T_2, T_3, T_4—175 kc. i.f. trans. (National)
T_5—Output trans., pentode to v.c. (5000 ohm pri.)
T—456 kc. b.f.o. trans. padded to 175 kc. with 500 μμfd. (Cond. C_{65})
V_1, V_2, V_3—956 tube
V_4, V_5, V_{12}, V_{13}—6SK7 tube
V_6—6SA7 tube
V_7, V_8, V_{10}—6J5 tube
V_9—6V6 tube
V_{11}—6H6 tube
Note: Coils L_1 through L_{15} are built on slug tuned forms (see text)



Tuning chart for the front of the superhet.

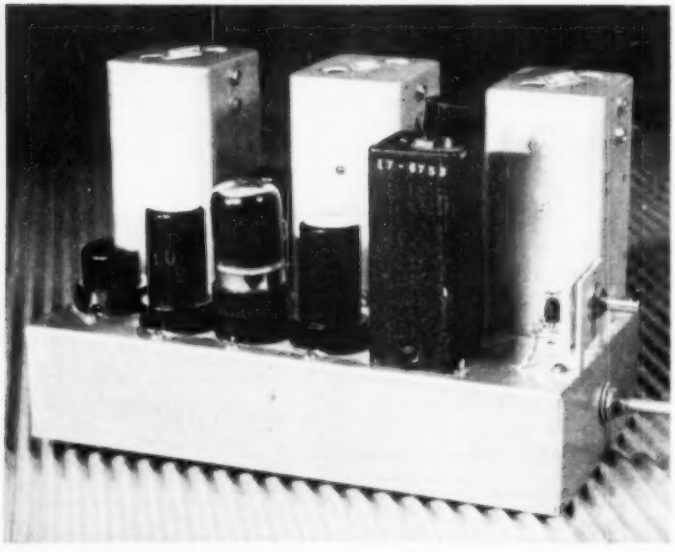
bolted to the foundation chassis. The oscillator of the converter is fixed tuned, and the oscillator padders are mounted in a ring on the end of the bandswitch assembly. The bandswitch wiring is as simple as possible. A system of paralleling inductances for the r.f. and mixer stages is used for coverage of all the ham bands.

The combined value of inductances in parallel is calculated the same as resistors in parallel and it is possible to cover a range of 3.5 to 30 mc. with only two inductances in each grid circuit. The mixer stage has a fixed trimmer for each band while the r.f. stage trimmer is adjustable from the front panel. The only adjustments required for changing bands are to turn the bandswitch and adjust the r.f. stage trimmer for maximum signal. Tuning from one end of the band to the other will require readjustment of the r.f. stage trimmer but normal frequency excursions will not. Fixed condensers could be used in the r.f. stage but this would require broadbanding and some inherent loss of sensitivity.

The first model of this converter used a harmonic oscillator, that is, the oscillator grid circuit was on a lower frequency and the output taken at the fourth or fifth harmonic from a tuned circuit in the plate of the oscillator. The purpose of this was to get good oscillator stability on the higher frequency bands. This system did not work, however, because of other than the wanted harmonics appearing in the plate circuit. These unwanted harmonics were very weak but they would beat with strong local signals and cause "ghosts" in the middle of the band. The stability of the system as described is very good and there is no need for better. Ten meter c.w. operation is a pleasure with this receiver and not the ordeal it was with the old conventional type receiver. No ground returns are made to parts of the bandswitch assembly itself, each stage has a common ground point and these points are all tied together. Trouble was experienced with oscillations in the r.f. stage when the bandswitch was used as a ground return. Note in the photograph of the converter that the antenna connections are right at the r.f. stage. The antenna leads are brought in through the side of the receiver cabinet at that point. It is best not to run the antenna leads through the receiver cabinet due to the possibility of the 3.4 to 4.2 mc. tuner picking up 80 meter signals. The bandswitch is made up of wafers of a single-pole eleven-position shorting type bandswitch with seven positions in use, leaving four blank for later additions. The oscillator uses six padders, the oscillator being disabled by shorting the grid coil for the 80 meter band when the r.f. and mixer stages are used as bandpass amplifiers. The output of the converter is taken from a tuned circuit in the plate of the mixer tube. The coupling between the plate and output winding is very tight for even output over the frequency range 3.4 to 4.2 mc. The converter output inductance is mounted directly under the fixed tuned converter in the foundation chassis. The output coil of the converter is shielded and shielded leads are used to reduce the possibility of pickup of unwanted signals. Note in the photograph the aluminum bracket supporting the trimmer condenser for the r.f. stage. This support is a strip of aluminum held to the bandswitch assembly by the mounting nut on the threaded shaft of the bandswitch. The ten meter band has no trimmer for the mixer stage, the stray capacity being sufficient to resonate the mixer inductance to 28 mc. This will change with individual layouts and design and may require a trimmer in other models.

The 3.4 to 4.2 mc. tuner of the receiver is a two-stage r.f. amplifier, mixer, and oscillator unit. This complete tuner is built on a 11" x 7" x 2" aluminum chassis. The r.f. stages are 6SK7's, the mixer a 6SA7, and the oscillator a 6J5. The four-gang tuning condenser is from a BC-603 tuning unit. The maximum capacity is 50 $\mu\mu$fd. per section with one plate removed from the three front sections and two plates from the double-spaced section. These tuning units, with push-buttons and dial, are available at surplus for $2.50 and they are better built than some standard models costing several times as much. Alternately, two 50 $\mu\mu$fd. dual minatures could be ganged. The tuning dial, push-buttons, and trimmers were all stripped off and some of the extra fittings filed off to make a neat and well shielded four-gang tuning unit. The coil shields were picked up in a surplus store, four for a dollar. They were originally used on some low frequency inductances and have $\frac{5}{8}$" diameter adjustable slugs in them. The coils inside the shields are five-prong, plug-in type coils that are a holdover from an earlier model receiver. These coils, thanks to the fixed tuned converter, are never plugged in or out. Having the tuning slugs and also the trimmers makes it easy to obtain good tracking over the frequency range 3.4 to 4.2 mc. Good tracking for this unit is important and the effort and time spent to achieve it will be well spent. The *Millen* type shielded coil with adjustable tuning slug would work as well or probably better than the coils used in this receiver. No matter what type coil is used it must be well shielded. There is no adjustable slug for the oscillator inductance, the tuning range being adjusted by the series padder mounted inside the coil shield. Good shielding of this tuner unit is important for several reasons; in keeping unwanted signals out of the tuner when tuning the higher frequency bands, in keeping harmonics of the tuner oscillator from being heard

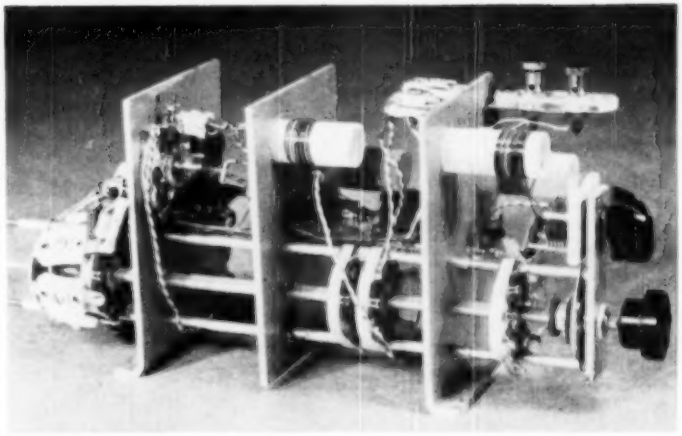
The i.f.-a.f. chassis. The two controls are the b.f.o. condenser and a.f. gain control.



through the converter front end, and in keeping the tuner oscillator from beating with strong signals and mixing in the r.f. stage of the fixed tuned converter. All three of these conditions have been experienced with earlier unshielded models. Many different combinations of heterodyned frequencies are possible with two oscillators in one receiver. The output of the tuner is on 175 kc., with a 175 kc. i.f. can mounted on the tuner chassis. This transformer is loosely coupled, capacitively, to the input i.f. transformer in the i.f.-a.f. unit. The coupling is about 2 or 3 $\mu\mu$fd. of capacity which is made up of two pieces of insulated wire twisted together for half an inch or so. This condenser is C_{a} on the schematic.

The i.f.-a.f. chassis is a 9" x 5" x 2" aluminum unit with two i.f. stages, a second detector-a.v.c., a b.f.o., and two audio stages. The i.f. stages are on 175 kc. and the input transformer is loosely coupled to the i.f. transformer in the plate circuit of the 6SA7 mixer in the tuner unit. This coupling capacity should be adjusted for good selectivity. The i.f. transformers are *National* 175 kc. cans. These cans, as supplied, were equipped with 1 megohm resistors across one of the windings. These resistors were removed to improve the "Q" of the transformer. The b.f.o. transformer is a 456 kc. b.f.o. can padded with additional capacity to 175 kc. One half of the 6H6 is not used, the second detector being a conventional diode which also supplies the a.v.c. voltage. The audio gain control is mounted on the i.f.-a.f. chassis and the shaft is long enough to extend through the front panel. The b.f.o. trimmer is also mounted on the i.f.-a.f. chassis and is coupled to a bearing shaft on the front panel with a flexible coupling. The i.f. gain is external to the i.f.-a.f. chassis and the lead to it is carried in a cable. The standoff terminal beside the 6H6, visible in the photograph, is an output connection across the diode load resistor for connecting an oscilloscope for visual alignment of the i.f. system or for connecting a v.t.v.m. for conventional alignment. The b.f.o. trimmer condenser has one corner of one of the rotor plates turned down so that when completely meshed it shorts and disables the beat oscillator. The output transformer, a small pentode-to-voice coil job, is mounted external to the i.f.-a.f. chassis on the foundation chassis. Note in the schematic the switch, S_{a}. This "Tone Control" has been found valuable in cutting down the annoying heterodynes from adjacent channel stations.

The "S" meter is in a bridge circuit in the plates of the two i.f. stages, these are the only stages biased with the a.v.c. system. Using a bridge type circuit for the "S" meter enables us to use an ordinary 0-1 ma. meter. The dial is a *National* NPW-O type with gear box. This dial is, in my opinion, the best on the market for ham receiver use and well worth its



Assembled view of the fixed tuned converter. This photograph shows the method for mounting the oscillator padders in a ring on the end of the receiver's bandswitch.

$9.00 net price. In choosing a dial for your home-brewed receiver it is well to remember that the dial will get more physical use than any other control on the receiver and a cheap dial can spoil the operation of an otherwise excellent receiver. The calibration chart is mounted directly under the dial; it is mounted behind a piece of lucite which is held on with four small machine screws. The tuning chart, like the plug-in coils, was always missing when needed before it was mounted on the receiver panel. The panel is a standard size 19" x 8¾" aluminum panel painted with a light gray enamel. A cabinet is required in a receiver of this type because of the necessity for good shielding.

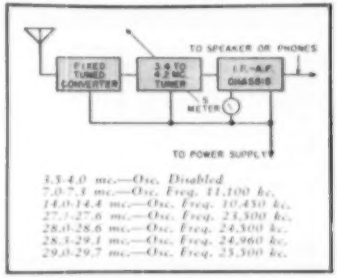
When aligning the three sections it is best to align each unit individually before trying them all together. The fixed tuned converter could be used with a separate receiver tuning from 3.4 to 4.2 mc. and all the circuits peaked up. The oscillator of the fixed tuned converter can be set and checked with a general coverage receiver with a fairly accurate dial calibration or with a frequency meter.

The tuning range of the 3.4 to 4.2 mc. tuner is set with the series padder in the oscillator. After the tuning range has been set the two r.f. amplifiers and mixer trimmers and slugs are adjusted for good tracking. Some trimming of the inductances may be necessary to get good tracking.

The i.f. transformers on 175 kc. should be adjusted with a signal generator. If a sweep type signal generator is available a scope can be connected to P_{i} for visual alignment. If an ordinary type signal generator is used a v.t.v.m. may be used for indication across P_{o}.

The power supply for the receiver should provide 250 volts d.c., well filtered, at about 100 ma. and 6.3 volts a.c. at 6 amps.

While voltage regulation of the power supply is not necessary, it would



Block diagram of the receiver. Receiver frequency ranges with the corresponding oscillator frequencies are also given.

be an added refinement and can easily be accomplished with a VR105 and VR150 tube connected in series across the power supply output.

The fundamental design used in this receiver precludes the possibility of obsolescence in the event that different frequency coverages are wanted for any reason. Fixed tuned converters for different frequency ranges may be designed without the usual problems of tracking and their attendant difficulties.

The advantage of a definite tuning ratio saves many bandspread calculations.

Is this the final model? No, I'm thinking now, not of a bigger but of a better receiver. It would make a nice receiver with miniature tubes all the way through, crystals for the fixed tuned converter, and some other refinements. Perhaps gang tuning of the fixed tuned converter r.f. and mixer stages with the 3.4 to 4.2 mc. tuner, maybe even the same or better sensitivity in half the space with some of these new smaller components. One thing I'm convinced of; I have the right idea for tuning and bandswitching and the future models will be the same basic circuit as this receiver.

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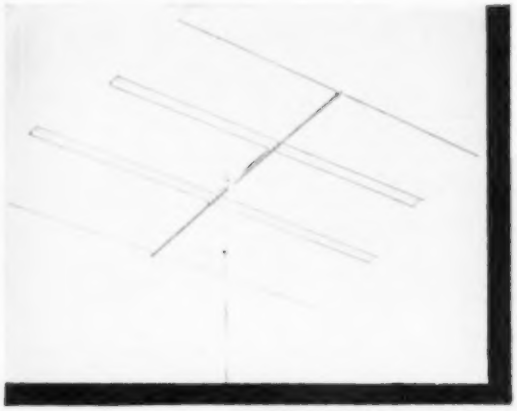
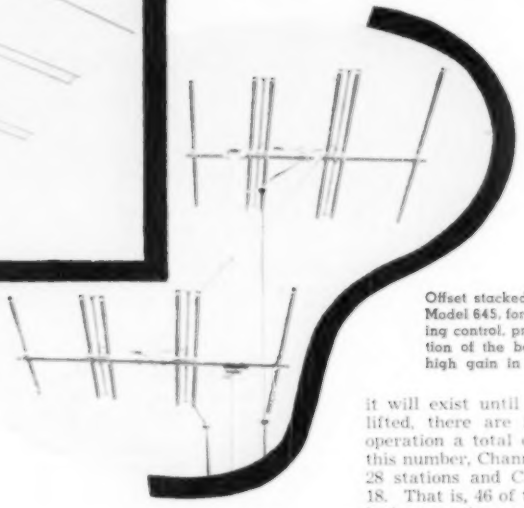
TWO-CHANNEL TV YAGI DESIGN

By
G. N. CARMICHAEL
Chief Eng., Trio Manufacturing Co.

New design provides good co-channel (4 and 5) operation in fringe areas.



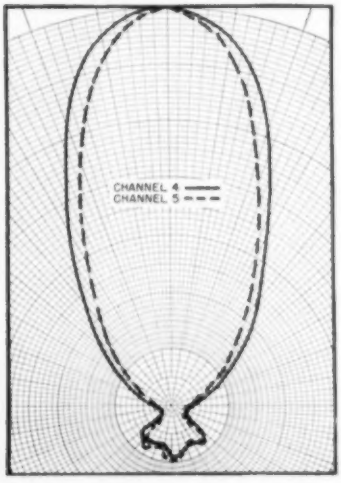
Single Yagi bay. Trio's Model 445 provides 10 db. gain over entire range from Channel 4 through 5. Front-to-back ratio is over 20 db. for total range. New design provides four-element Yagi performance from a single bay antenna.



Offset stacked Yagi array. This Trio Model 645, for use with voltage phasing control, provides maximum rejection of the back signal as well as high gain in the forward direction.

IT IS generally conceded that the Yagi antenna offers the best possibilities for TV reception in fringe areas. The characteristics of this type of antenna—high gain, sharp lobe pattern together with high front-to-back ratio, and low vertical wave angle response—combine to produce the necessary qualifications for a TV aerial for low signal level areas. However, the increasing number of channels available in many fringe areas has made installations of Yagi bays for each channel prohibitive because of cost and difficulty of installation. It is natural to consider the possibility of one bay having sufficiently broad frequency response to cover two adjacent channels. Experiments in tuning the elements to obtain this result are not too promising. Since the functioning of the parasitic elements of a Yagi antenna are dependent on dimensions and spacing to provide the proper phasing, it is not possible to have characteristic parasitic behavior over a range of frequencies which is any considerable percentage of the fundamental frequency.

Fig. 1. Voltage patterns on Channels 4 and 5.



The attempt to obtain adjacent channel operation of a single antenna bay is more difficult on Channels 4 and 5 because of the frequencies, 66-72 mc. for Channel 4 and 76-82 mc. for Channel 5. The fact that there is a break between these two channels means that a total range of 16 mc. must be covered, nearly 25% of the lowest frequency. Although this difficulty does not exist on other adjacent channels, and considerable success can be obtained on the high channels by a compromise tuning of the parasitic elements, it is on Channels 4 and 5 that the problem is most acute.

On the basis of the present allocations, which represent the situation as it will exist until after the freeze is lifted, there are now or will be in operation a total of 109 stations. Of this number, Channel 4 will contribute 28 stations and Channel 5 will have 18. That is, 46 of the 109 stations will be in operation on these two channels. For this reason, a further study of a single antenna bay for Channels 4 and 5 seems very much worthwhile.

A design was finally worked out on a basis which represents a new departure in parasitic antennas. In final form, the antenna consists of four elements whose functioning is different on the two channels. On Channel 4, the elements act as reflector, dipole, director, director, in that order; while on Channel 5, the same elements act as reflector, reflector, dipole, and director. In order to understand the possibility of such action, it should be remembered that the parasitic elements obtain their effect by the re-radiated and induced voltages which combine with proper phase relation in the active element and are delivered by the active element to the feedline. However, the active element, even at maximum efficiency, delivers only 50% of this voltage to the feedline. The remaining energy is, in large part, re-radiated. That is, an active element has some of the necessary characteristics of a parasitic element.

Final design was largely experimental, since there were no previous results on which to compute dimensions and spacing.

Fig. 5 shows the layout, dimensions, and spacing of the antenna. No constructional details are given since those will be a matter of personal preference. It is not necessary that

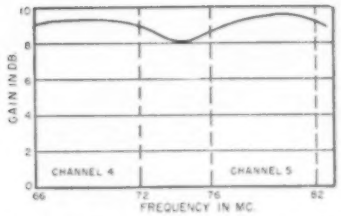


Fig. 2. Voltage gain over reference dipoles.

any of the elements be insulated from the boom except the center elements of the folded dipoles. These folded dipoles are critical as to element size and spacing, since the impedance step-up depends on the relative diameters and spacing. They consist of an active element of ⅝" o. d. paralleled by two elements of ⅝" o. d. each spaced 1½" center-to-center from the active element. The ⅝" active element is, of course, the active dipole and is broken at the center with a 1½" gap with the phasing strips connected at these points. The phasing strip is of 300 ohm twin-lead, transposed between the dipoles and with the feedline taken off 7½" from the point of attachment to the longer dipole.

Fig. 1 shows voltage lobes for channels 4 and 5. It should be noted that these patterns are typical Yagi patterns. The front-to-back ratio is not quite as high as can be obtained from a single channel four-element Yagi tuned for maximum front-to-back, but remains above 20 db. from the video carrier of Channel 4 through the sound carrier frequency of Channel 5. Fig. 2 shows voltage gain plotted against two reference dipoles, one for Channel 4 and one for Channel 5. Both Fig. 1 and Fig. 2 were obtained from received signals from stations at least 90 miles distant. It is the author's feeling that such data obtained from locally generated signals is practically valueless since it does not take into account the vertical wave angle involved in reception of distant stations.

Since the number of stations on Channels 4 and 5 is so large, there is another problem of increasing importance in fringe areas, that of co-channel interference. For example, at the author's home, in west central Illinois, the following stations create a difficult situation: KSD-TV Channel 5, 92 miles south, 20 degrees east; WOC-TV Channel 5, 125 miles north; WNBQ Channel 5, 240 miles northeast; WHBF-TV Channel 4, 125 miles north; WBKB Channel 4, 240 miles northeast; and WDAF-TV Channel 4, 240 miles west. No conventional antenna has provided a solution to the interference existing on these channels. However, another approach to the problem has provided a means of reception.

Fig. 3 shows two of the antenna bays just described installed in such a way that a wavefront will intercept the two bays with a phase difference. For a signal from a forward direction, this phase difference will be of the order of 90 degrees with the voltage in the lower bay leading the voltage in the upper bay. A signal from the rear will provide a phase difference of approximately the same amount, but in this case, the voltage in the lower bay will lag. With separate feedlines brought down to the ends of a 42" open-wire line, as in Fig. 4, and with a variable tap on this line to provide the exact phasing required, it is possible to obtain practically complete suppression of the unwanted signal while still maintaining high forward gain for the desired signal. It may be necessary to reverse the connections to one end of the open-wire line to provide the necessary phasing.

The spacings required in Fig. 3 are 67" distance between upper and lower bays, and a total offset of 37" obtained by mounting the upper bay 15" back of its director, with the lower bay 15" forward of its reflector.

An antenna embodying the principles involved in this article is produced by *Trio Manufacturing Co.* of Griggsville, Ill. In order to provide manual control of the phasing, the open-wire line is replaced by a fixed inductance with a continuously variable tap. This, together with a d.p.d.t. switch for transposing one of the feedlines, gives complete control of the required voltage phase.

By means of the phasing control, the interfering signal may be "tuned out," permitting interference-free reception of the desired station. The over-all effect of this adjustable feature is to make reception possible under conditions that normally would be unsatisfactory for enjoyable television viewing.

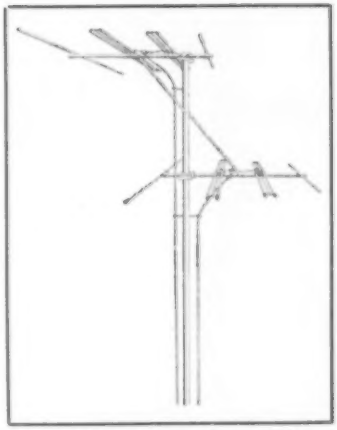


Fig. 3. Offset Yagi bays to provide independent voltages to the phasing control.

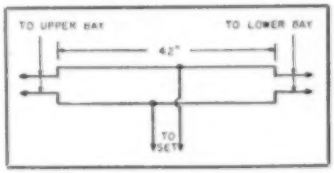


Fig. 4. Open wire line for proper phasing.

It may be of interest to readers to know that the author, during the development work on this antenna in the summer months of 1950, logged 24 of the 39 stations then in operation on Channels 4 and 5.

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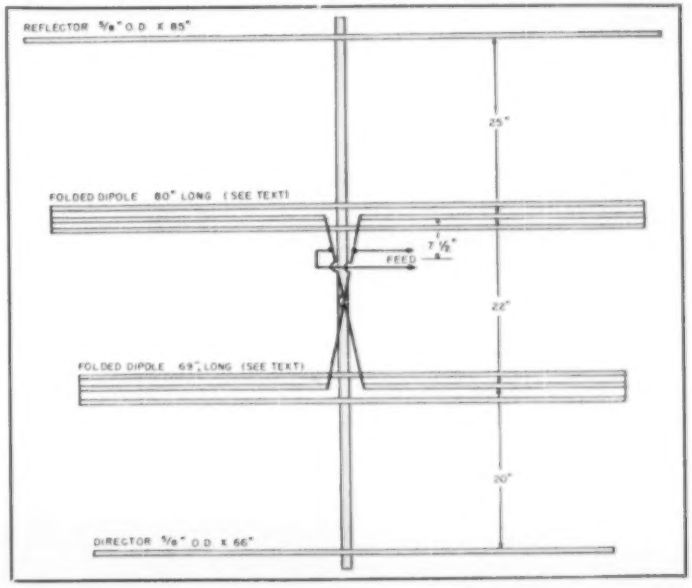
Fig. 5. Over-all dimension of Yagi antenna designed for operation on Channels 4 and 5.



Adding a Frequency Sweeping Circuit to the Wien Bridge Audio Oscillator

By HUBERT SEAR

This sweep frequency circuit can be added to any Wien bridge audio oscillator. It is easy to build and requires only one tube.

THE purpose of this article is to present a method for making a sweep frequency audio oscillator other than that discussed by Glen Southworth in his article "Build a Sweep Frequency Audio Oscillator" which appeared in the February 1950 issue. In Mr. Southworth's article, a beat frequency type of audio oscillator is described in which the output of a fixed frequency and a variable frequency oscillator, both operating near 455 kc., are mixed in a non-linear detector. The difference frequency thus generated falls in the audio range. The tank circuit of the variable oscillator is tuned with a fixed condenser and a small variable air-dielectric condenser, rotated by an electric motor thus causing its output frequency to vary. This changes the difference frequency generated in the detector throughout the audio frequency range.

The same results may be obtained more simply by making the following modification of the Wien bridge oscillator—a well-known source of very stable audio oscillations. The frequency determining component of this type of oscillator is an *RC* network. The principle of operation of the Wien bridge oscillator may be summarized by the statement that the phase shifts around the circuit (see Fig. 1) are zero at only one frequency, that is, the frequency where the *RC* network reactances are: $R_1X_{C_1}=R_2X_{C_2}$; $R_1=X_{C_1}$; $R_2=X_{C_2}$. At this point oscillations occur at a frequency Fo, determined by the formula:

$$Fo = \frac{1}{2\pi\sqrt{R_1C_1R_2C_2}} = \frac{1}{2\pi RC} = \frac{1}{2\pi R_2C_2}$$

It is clear from these equations that any change in R_1 and R_2 or C_1 and C_2 changes the frequency of oscillation. The two resistances or the two capacitances must be changed together to satisfy the reactance equations.

Sweeping of the audio frequency spectrum would result if R_1 and R_2 were each shunted by a changing resistance such as the plate resistance of a vacuum tube. The plate resistance can be changed by varying the voltage on the vacuum tube grid. This arrangement is indicated in Fig. 2. A miniature tube, the type 12AU7, is used in this circuit although a 6J6 or other twin-triode could be used. In this case the miniature tube was used in order that this circuit could be installed in a Wien bridge oscillator which was already on hand. It is important that both triodes be in the same envelope in order that their characteristics, which change with the aging of the tube, change together.

Editor's Note: A review of the advantages and applications of a sweep frequency audio oscillator is purposely omitted from this text. Glen Southworth, in his recent article "Build a Sweep Frequency Audio Oscillator" published in the February 1950 issue, covered these points quite thoroughly and readers may refer to that issue.

The plate voltage for this tube is obtained from the oscillator power supply. The grid voltage, applied equally to both tubes, swings between minus 20 volts and plus 5 volts, changing the plate resistance of both triodes from about several thousand megohms when the tube is cut off to about 4000 ohms when it is conducting the maximum allowable current at this plate voltage. The a.c. grid voltage may be obtained by a resistor across the 60 c.p.s. power lines, tapped to give 25 volts peak-to-peak or 8.9 volts r.m.s. (as read on an ordinary voltmeter).

A convenient divider giving these approximate voltages may be made up of a 1250 ohm resistor in series with a 14,150 ohm unit. The values required are not critical and stock values of 1200 and 15,000 ohms will be satisfactory.

The condensers C_1 and C_2 should be matched to within 1% by means of a bridge. Again the exact values are not too critical and condensers may be paralleled to give the approximate values specified.

Resistors R_1 and R_2 must also be matched to within 1%. The value required for these two resistors will be determined, to some extent, by the resistors in the Wien bridge oscillator. When connected to the oscillator, different sizes of resistors may be tried and the optimum value determined by experiment.

The output connections shown in Fig. 2 are connected in parallel with the Wien bridge oscillator's frequency determining circuits. The exact connections will depend on the oscillator circuit used. The series resonant circuit R_3, C_3 would be connected in parallel with the equivalent series

resonant circuit in the oscillator. The parallel resonant circuit R_n, C_n is connected in parallel with the equivalent circuit in the oscillator. A common ground lead is also run between the two units.

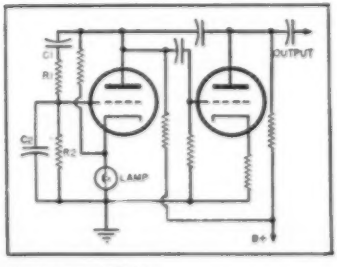
The 20 μfd. condensers may be obtained with a paper dielectric or as electrolytics. If the latter is used, care must be taken that the correct polarity is observed.

The circuit may be disabled by disconnecting the plate voltage, thus allowing the use of the audio oscillator as originally designed. The Wien bridge oscillator controls should be set at the lowest frequency of the instrument when using the sweep tube.

Equalization of the two triodes may be necessary with small series resistors in the cathode leads. Different types of grid waveforms allow logarithmic or differential sweep of the audio spectrum. These special waveforms may be generated from the 60 cycle power line sine wave by limiting, clipping, and the proper filters.

Small parts of the spectrum may be swept by changing the extent of grid voltage swing. Isolated regions can be swept by clipping the peaks of the applied sine wave with back-to-back rectifiers, as shown in Fig 3. The operation of this circuit is made clear with the aid of Fig. 4 which shows the relations of grid voltage to frequency in the 12AU7 tube. If the frequency range between *A* and *B* is to be examined, grid voltages between *C* and *D* must be swept. That is, the output waveform shown in Fig. 3 is required. It is obtained with the biased rectifiers. $Rect._1$ and $Rect._2$ They are in series with an adjustable bias produced by R_7-C_3 and R_8-C_4. When the applied voltage is zero, a voltage exists on the bias network from a previous cycle. As the applied voltage increases, $Rect._1$ acts as an open switch as long as this voltage does not exceed the bias. When it does, $Rect._1$ conducts, maintaining the applied voltage at a constant level set by the value of the bias. The current passed by $Rect._1$ is used to charge C_3 which will maintain the bias voltage across the resistor. When the applied voltage falls below the bias, $Rect._1$ stops conducting and the applied voltage is transmitted to the 12AU7 grid exactly as it appears across the 1250 ohm input resistor.

Fig. 1. Circuit diagram used to explain the principle of operation of a Wien bridge audio oscillator. See text for reference.



The same operation occurs on the negative swing of the applied voltage in $Rect._2$, R_7 and C_3. The part of the 25 volt wave that is allowed to pass to the 12AU7 grid can be varied by changing the bias voltage developed, *i.e.*, by changing the setting of R_7 and R_8. In this manner it is possible to obtain any asymmetrical clipped wave which would be required. Such a wave would be used to sweep the region *EF* in Fig. 4 which requires a grid voltage swing lying asymmetrically about the d.c. grid bias of the 12AU7.

Due to the slight charge and discharge of the integrating *RC* networks in series with the rectifiers, the clipped wave developed is not exactly flat-topped as shown in Fig. 3. This would cause a change in the plate resistance of the triodes, but it can be shown that it does not affect the frequency of the Wien bridge oscillator significantly. There is a 12 per-cent change in the 12AU7 grid voltage when clipping above the 1 volt level due to discharging of C_3 and C_4. This causes an error in output frequency of .05 per-cent at 10,000 c.p.s. C_3 and C_4 discharge even less when clipping at higher levels (only 10 per-cent when clipping above 10 volts). Therefore, it is clear that this circuit affects the accuracy of the Wien bridge oscillator in no truly significant manner.

It has now been shown that by the application of electronic methods to an instrument that is known for its accuracy and reliability, the Wien bridge audio oscillator, an increase in the flexibility of the instrument is achieved. In the beat frequency type oscillator inaccuracies of output frequency occur due to drifting of the high frequency oscillators, a thing which is avoided in the Wien bridge oscillator. The initial zero beating, required in the type of instrument described by Mr. Southworth, is needed before it is used but is avoided by the use of the circuit described herein. Lock-in occurs in the high frequency beat oscillators when they are operated very close to the same frequency in an attempt to get a very low audio frequency beat note. Mr. Southworth reports that this occurs when the audio frequencies approaching 100 c.p.s. are developed and the output of the instrument suddenly drops to zero. Lock-in of the high frequency oscillators may be minimized by special shielding and careful electrical isolation of the two oscillators. This is not required in the Wien bridge oscillator.

When using the sweeping circuit described here, sweeping at 60 c.p.s., obviously frequencies lower than this cannot be swept. However, it is not necessary for the grid excitation to be obtained from the 60 c.p.s. power lines. Lower frequency vibrators or flasher units used in advertising displays may be used to produce the grid drive, thus allowing the lower frequencies, available from the Wien bridge oscillator, to appear in the output.

The above-mentioned features, plus the absence of mechanical parts and special construction, as well as the ease with which the circuit may be added to existing equipment, recommends this type of sweep frequency audio oscillator to the radio technician or experimenter.

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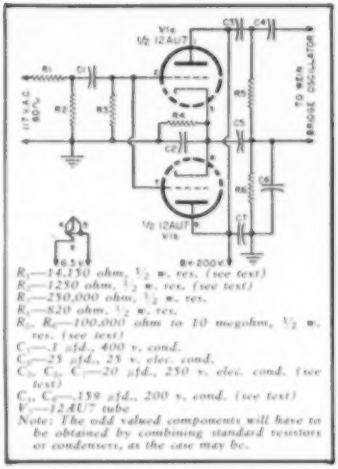


R_1—14,150 ohm, ½ w. res. (see text)
R_2—1250 ohm, ½ w. res. (see text)
R_3—250,000 ohm, ½ w. res.
R_4—820 ohm, ½ w. res.
R_5, R_6—100,000 ohm to 10 megohm, ½ w. res. (see text)
C_1—.1 μfd., 400 v. cond.
C_2—25 μfd., 25 v. elec. cond.
C_3, C_4, C_5—20 μfd., 250 v. elec. cond. (see text)
C_6, C_7—150 μfd., 200 v. cond. (see text)
V_1—12AU7 tube
Note: The odd valued components will have to be obtained by combining standard resistors or condensers, as the case may be.

Fig. 2. The frequency sweeping circuit. This circuit may be incorporated in any Wien bridge audio oscillator the constructor may have on hand. Actually, the resistance of both plates of the dual triode vary at a predetermined rate, thus sweeping the oscillator circuit of the bridge unit.

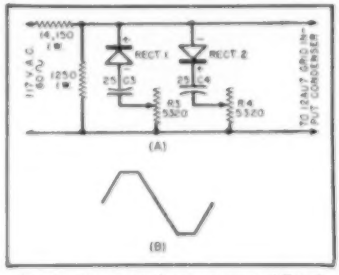
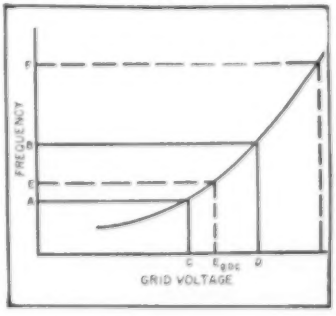


Fig. 3. Circuit used across input of Fig. 2 if greater flexibility of sweep is desired. Isolated regions can be swept by clipping the peaks of the applied sine wave with rectifiers which are connected back-to-back.

Fig. 4. Curve showing the relationship of 12AU7 grid voltage and the frequency.



CONSISTENT FRINGE AREA TV RECEPTION

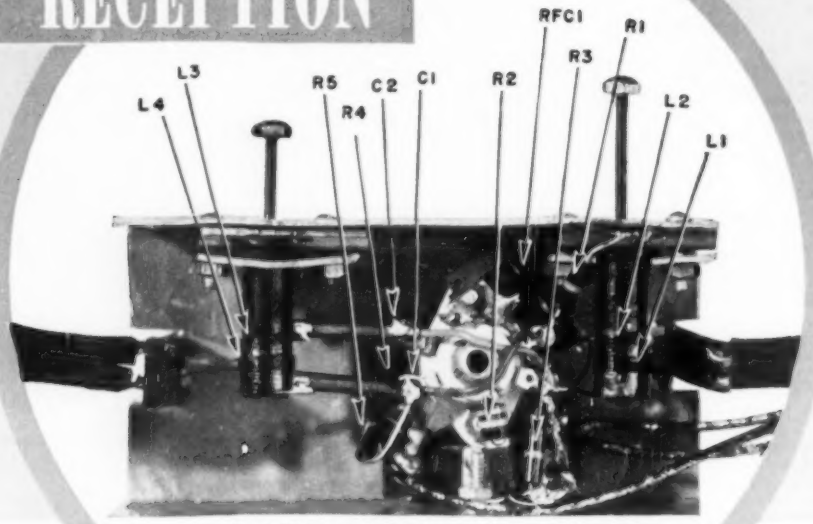
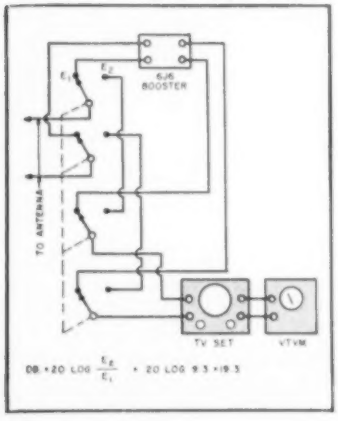


Fig. 1. 6J6 booster built for use on Channel 5. Actual size is 4" x 2". Coils were made from salvaged slug-tuned forms.

By
RICHARD J. BUCHAN,
W0TJF

An antenna and booster combination having a 38.9 db. gain. The booster is compact and easy-to-duplicate.

Fig. 2. Test setup to determine booster gain under actual receiving conditions. The v.t.v.m. connections to TV set are the same as those shown in Fig. 8. Tests were made under weak signal conditions to minimize the effects of a.g.c. Voltage ratio of 9.3 was average of ten tests.



OVER a year ago KSTP-TV, located 105 airline miles north of Bricelyn, Minnesota, started telecasting with an antenna slightly over 500 feet high and a power of 25 kilowatts. After studying antenna books and experimental charts put out by the FCC, the conclusion was reached that a 2.5 microvolt signal (except for a temperature inversion) was about all that could be expected. In spite of this, a small set was purchased and connected up. The actual results would tend to verify this 2.5 microvolt value; although means of actually measuring the signal were not available. Assuming that a 250 microvolt signal would be necessary for excellent reception using a straight dipole, it was concluded that a 40 db. gain would have to be obtained through a high gain antenna-booster combination. This figure seemed impossible to obtain without a massive antenna array and a super booster.

Since then a series of boosters and antennas have been built. All (both the antennas and boosters) had the typical characteristic faults. The boosters, using 6AK5's with tuned input and output circuits, showed good gain but little if any improvement in signal-to-noise ratio, and the serious fault of insufficient bandwidth which seriously degraded the picture definition. Loading the tuned circuits did help this situation, but resulted in loss of badly needed gain. Various commercial boosters were tried—but all lacked something. In fact, some even lowered the signal-to-noise ratio although they did have good gain. The next to the last booster built, using two 6J4's in cascade, did result in a

EDITORS' NOTE. In the course of preparing this article for publication it was suggested that this same booster could be used as a 2 meter preamp. Although it has not actually been tried in this application, all indications are that this unit, with the proper coils, could be used for this purpose. Theoretically, it is possible to obtain a 20 db. gain at 200 mc. It should be possible to cover the 2-m. band without retuning.

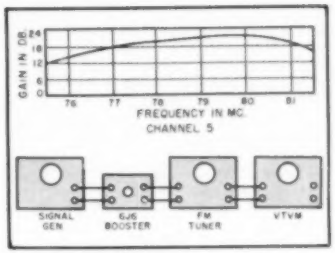


Fig. 3. Test setup and graph showing broadband booster response. The equation for determining db. gain is the same as that shown in Fig. 2. The voltage E is obtained with the signal generator connected directly to the FM tuner and the output adjusted to 1 volt on the v.t.v.m. E, is obtained with the booster in the circuit and the FM tuner adjusted for maximum output at each frequency.

signal-to-noise ratio improvement, good gain, and not too selective tuning. The final booster built used a single 6J6 in a tuned-plate, tuned-grid neutralized circuit. Slug-tuned coils were used with only the tube and stray capacitance across the tuned circuit. This resulted in a booster having a very good signal-to-noise ratio, 19.3 db. gain (See Fig. 2) and an extremely broad band as shown in Fig. 3. It is indeed gratifying to switch in the booster and watch the snow diminish (instead of increasing as with most boosters), the large increase in picture contrast and brightness, and because of the broad tuning no degrading of the picture quality. A further advantage is the circuit which is completely balanced in every respect. This results in a very definite reduction in noise due to ignition and other forms of electrical interference. Circuit and construction details are shown in Fig. 5, and a photograph of the original booster built for Channel 5, using ⅜" slug-tuned forms from a junked broadcast receiver, is shown in Fig. 1. Since it would be difficult to obtain coil forms such as were used in the original boosters a third booster was constructed using *National* XR 50 coil forms in order to obtain coil data for all channels using commercial type forms. Although one booster using these forms will tune four of the five low channels and all the high channels, separate boosters for each channel were built for the following reasons:

1. It is rather slow to adjust the two tuning slugs for each channel. This would be especially true if tuning from Channels 3 to 6, or 7 to 13.

2. It is easier to adjust the tuning with a signal generator and output meter than with the station signal. Lacking this equipment a very good adjustment can be made using the station signal if a time is picked when little fading is present.

3. Although neutralization could be sufficient to prevent oscillation over the entire high or low band with one adjustment, a better signal-to-noise ratio can be obtained by accurately neutralizing the booster for each channel. Fig. 4 shows a booster switching circuit for convenience in changing stations or cutting the booster completely out of the circuit. It certainly enhances the entertainment value of TV to be able to change stations without having to retune the booster each time. This feature becomes even more important when others in the family operate the set. In the event standing waves are present on the antenna transmission line or the line between the booster and the set, a definite improvement can be made by connecting a small variable condenser (10 to 20 $\mu\mu$fd. maximum capacity) across the transmission line at the set or booster input and adjusting it for maximum gain. A simple test for standing waves can be made by pinching the twin lead between the thumb and forefinger at various points along the line. A noticeable increase or decrease in picture brightness indicates the presence of standing waves, the magnitude being indicated by the amount of change. If difficulty is experienced in tuning the booster or obtaining the gain it should have, be sure and make this test.

The experience has been the same in antenna building. Two three-element arrays stacked a half-wave apart, four two-element arrays stacked a quarter-wave apart, four four-element arrays stacked quarter-wave, cubical quads, single four-element arrays, and a few more antennas of various types have been tried. One thing I did learn, the antenna theory to be found in books does work out in practice; and one thing in particular—you don't get something for nothing (except in the last antenna built). When a three-element parasitic array is supposed to have a 7 db. gain, that's

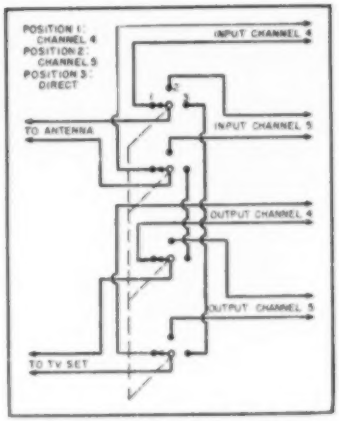


Fig. 4. Switching circuit used with separate boosters for Channels 4 and 5. This also makes an ideal setup for comparing the actual performance of two boosters.

what it will have, and it will have to be well built to get that. The parasitic arrays all had the same common fault—tune them up for maximum gain on the video frequency and you get practically no sound; broadband them to cover both sound and video frequency and the gain starts to drop off; build one for Channel 5 and there will not be much pickup on Channel 4; tune them for a high front-to-back ratio on the video frequency, and very little front-to-back ratio on the sound frequency; tune them for a compromise front-to-back ratio and not sufficient attenuation is available on either video or sound channels to cut out a station with equal signal strength to the rear. The entrance of WOI, Ames,

Fig. 5. Circuit diagram and construction notes, including coil data, on the 6J6 booster.

COIL DATA USING NATIONAL XR 50 FORMS

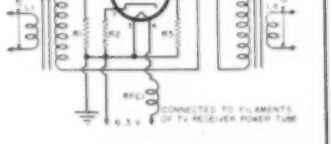
Channel	L_1, L_2	L_3, L_4
	t.	
7,8,9, 10,11, 12,13	1 t. #22 plastic wound directly over center of L_3, L_4	3 t. #16 en. spaced 1/16"
5,6	3 t. #22 en. insulated from L_3, L_4 by layer of cellophane tape. Same spacing as L_3, L_4	7 t. #22 en. spaced 1/16"
3,4,5,6	3 t. #22 en. insulated from L_3, L_4 by layer of cellophane tape. Same spacing as L_3, L_4	9 t. #22 en. spaced 1/16"
2,3,4	3 t. #22 en. insulated from L_3, L_4 by layer of cellophane tape. Same spacing as L_3, L_4	11 t. #22 en. spaced 1/16"

Note: 1/16" is the entire available winding space on the XR 50 coil form.

R_1, R_2—100,000 ohm, 1/2 w. res.
R_3—47 ohm, 1/2 w. res.
R_4, R_5—25,000 ohm, 1/2 w. res.
C_1, C_2—Approx. 1/2" of #22 plastic covered wire inserted in 1/8" copper tubing and connecting the tube plates to the coils
RFC—#22 en. closewound on 1/4" form, 1 1/4" winding length
L_1, L_4 (Channel 4)—2 t. #22 plastic covered wire closewound over L_3, L_4 with cellophane tape between the two windings
L_3, L_4 (Channel 4)—6 t. #22 en. spaced to occupy 1/2" on 7/8" slug-tuned form from 274 series surplus transmitter
L_1, L_4 (Channel 5)—4 t. #22 en. closewound over L_3, L_4 with cellophane tape between the two windings
L_1, L_4 (Channel 5)—11 t. #22 en. closewound on 5/8" slug-tuned form salvaged from junked b.c. set

Note: To neutralize, disconnect the filament and adjust C_1, C_2 for minimum output. The null is very definite. If oscillation occurs readjust. The test setup of Fig. 3 is ideal for this adjustment. C_1, C_2 are adjusted by changing the distance the plastic wire is inserted in the copper tubing.

Tuning: Adjust L_3 for maximum output at video frequencies. Adjust L_4 for maximum output at audio frequencies. The tuning is very broad and it may be necessary to vary the number of turns or the spacing in order to hit a peak.



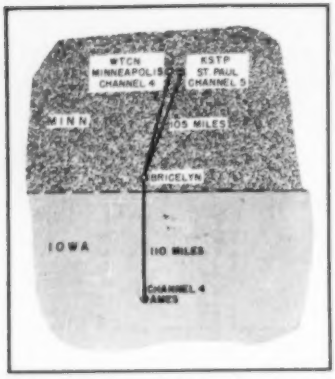


Fig. 6. Location of Bricelyn, Minn. in relation to TV stations operating in area.

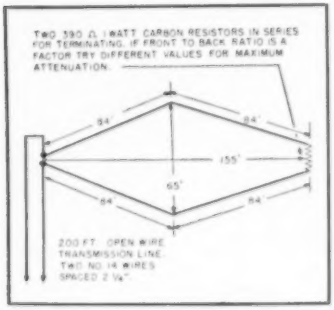


Fig. 7. Rhombic designed for zero-wave angle Channel 4, 5¾ wavelengths per leg.

Iowa, into the video field on the same channel as WTCN (Minneapolis, Minnesota, Channel 4) directly in line and the same distance to the rear really caused trouble. The diagram in Fig. 6 illustrates the problem involved. After a week of experimenting with a four-element array, tuning it for maximum front-to-back ratio with a signal generator exciting a folded dipole and an output meter connected across the output of an FM tuner connected to the four-element beam, the conclusion was reached that the only solution was to build four antennas—separate arrays for picture and sound for both Channels 4 and 5. The experiment further indicated that even then complete suppression of WOI could not be obtained, and anything over a 7 db. gain would require four big separate antennas. No attempt was made to receive WOI. The "Laker" basketball games and state basketball tournament over WTCN was what I was working for.

About this time the statement was read in an antenna book that a rhombic cut for an odd multiple of quarter wavelengths to a leg had an infinite front-to-back ratio. A rhombic 3 and ¾ wavelengths to a leg was hastily constructed. Even though tied to a power pole, telephone pole, top of the house and not over a few feet from telephone lines, it not only cut out WOI almost completely, but had a definite gain over the present antenna in use. This, to me, was a surprise since the rhombic was not over twenty feet off the ground and the antenna in use was a pair of three-element beams stacked a half-wave apart and matched to a 300 ohm line through an open quarter-wave matching stub tuned for maximum gain. Furthermore, not a "Laker" basketball game over WTCN had been missed over the entire season with this antenna. This whole array was 40 feet off the ground compared to about half that for the rhombic. Theoretically, the rhombic should have had about the same gain as the parasitic array if it were the same distance off the ground. The improvement could be attributed to the zero wave angle for which the rhombic was designed—a much more favorable angle for fringe area reception than can be obtained with a parasitic array; or it could substantiate the theory that in the case of long antennas the gain in receiving exceeds the gain in transmitting because of the large area exposed to the signal. At any rate, the rhombic was so successful that a permanent one was designed 5¾ wavelengths to a leg and supported by 45 foot "A frame" masts constructed from 2x3 timbers, 24 feet in length. The results exceeded my expectations—despite the performance of the temporary rhombic. Both WTCN and KSTP were received with equal signal strength, no discrimination between sound and video frequencies, no interference from WOI except for an occasional gurgle on the sound due to the carrier beats, plus a 9.6 db. gain (see Fig. 8B) over the pair of stacked three-elements previously described. I had always considered this antenna to have a 10 db. gain although no actual measurements were made over a reference dipole. Using 10 db. as a basis, that would give the rhombic a 19.6 db. gain for receiving. There are, of course, many variables involved, such as the five foot difference in height, a more favorable location for the rhombic (an open field across the road with a 200 foot open wire transmission line) or the six-element array may not have an actual 10 db. gain. For further construction details see the article "Rhombic Antennas for Television" by Woodrow Smith in the October, 1949 issue of RADIO & TELEVISION NEWS. Since there are good books on rhombic design, and since every case is different because of the available space, actual design and constructional details will not be discussed here. The dimensions of the final rhombic are given in Fig. 7. For those interested in the effect of height, a loss of 6 db. was experienced by lowering the antenna from 45 to 22½ feet. This would tend to verify the theory that the voltage pickup is directly proportional to the height.

The 6J6 booster and final rhombic antenna were completed about the same time. The combined gain equals 38.9 db. Somewhat short of the original goal of 40 db. but still a lot of gain. A comparison of the reception with the previous antennas and booster (two 6J4's) was indeed a revelation which not only made me feel that the year of part time experimenting had not been in vain but also prompted the writing of this article.

A record of the performance of the antenna-booster combination has been kept. Since what one person might call good performance another might call fair or even poor, I have set up a code of standards which is used in recording the antenna performance. The performance record is given below covering each evening from the time the antenna was completed until this article was in the mail.

Excellent—Movie definition, perfect sound, no fading, no snow. Reception such as that expected in the primary service area of the station.

Good—Slight snow, good definition, perfect sound, some slight fading.

Fair—Some snow, fair definition, good sound, occasional fade.

Poor—Snowy, considerable fading, poor definition, fair sound. Still entertaining (especially sporting events).

Very poor—Not worth watching, but still some picture and sound.

The Record: Excellent—4; Good—6; Fair—5; Poor—2; Very Poor—1. The "very poor" night occurred during a severe sleet storm and it is believed the lack of signal was due to ice on the open transmission line rather than because of a weak signal.

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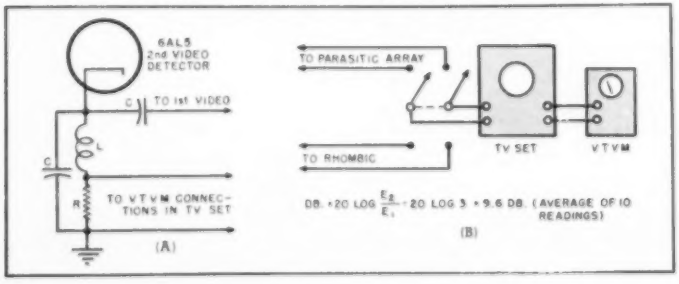
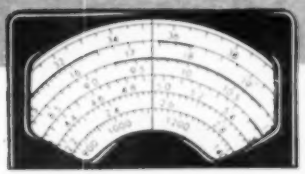
Fig. 8. (A) Method of connecting v.t.v.m. to TV receiver. (B) Test setup to determine gain. Tests were made without booster and with low signal input to minimize a.g.c. effects.



International SHORT-WAVE



Compiled by **KENNETH R. BOORD**

IT'S a pleasure this month to dedicate the *ISW Department* to radio in Mozambique, Portuguese East Africa. Our thanks go to the *International Monitoring Service*, San Carlos, California, for this current data, received direct by IMS from the station:

The *Radio Club of Mozambique* transmits in both Portuguese and *English*. In Portuguese, the station operates as the *Radio Club of Mozambique*, but for the *English* transmissions it is called—for convenience—*Lourenco Marques Radio*, explains Frank Lamping, the director for Davenport & Meyer (Pty.) Ltd., Hendon House, 42, Pritchard St., Johannesburg, South Africa, managers in the Union of South Africa. The Portuguese section operates on a limited commercial basis, but *Lourenco Marques Radio* is wholly commercial and has built up a large listenership in the Union of South Africa and in adjacent territories. *Lourenco Marques Radio* numbers among its sponsors such internationally-known firms as *Colgate-Palmolive Peet, Sterling Drugs, Chesebrough Mfg. Company, Proctor & Gamble, Richard Hudnut*, and others.

Lourenco Marques Radio has programs in *English* at 2300-1100 (Sundays from 0000) on 11.8 (actually this is approximately 11.764, although the station lists it currently as 11.8) and 4.93; 1100-1600 daily on 3.49 and 4.93; has *no* news bulletin. Programs consist of music, dramatic shows, and so on, with commercial announcements.

Radio Club of Mozambique radiates programs in Portuguese at 0000-0100 daily, 0400-0600 Sundays, and 0430-0630 weekdays on 9.67 (actually, this appears now to be approximately 9.805), 1100-1500 daily on 4.82 (actually, more recently has also been noted on the approximately 9.805 channel to 1500 by Pearce, England), and 1100-1300 daily on 15.209 (may be as low as 15.190 at times); news in Portuguese is scheduled 0015 (weekdays), 0530, 1200, 1320 (weekdays), and 1450 (weekdays); other programs consist generally of musical entertainment.

Identification for the *English* transmissions usually is each quarter or half hour—consists of four chimes followed by the announcer saying—"Lourenco Marques for Happy Listening in the . . . meter bands from six o'clock in the morning until eleven o'clock at night"; the interval-signal for *English* transmissions is "Sarie Marais."

Reports are welcomed and are answered by QSL cards; QRA is Radio Club of Mozambique, P.O. Box 594, Lourenco Marques, Mozambique, Portuguese East Africa.

Stations were listed as CR7AA, 11.8 (11.764?), 7.5 kw.; CR7AB, 3.49, 7.5 kw.; CR7BC, 15.19, 10 kw.; CR7BU, 4.93, 7.5 kw.; CR7BE, 9.67 (now 9.805?), 10 kw.; CR7BJ, 9.77, 7.5 kw., and CR7BV, 4.82, 7.5 kw.

Mozambique, Portuguese East Africa, extends from Cape Delago (10° 40' south latitude) to the Union of South Africa; to the west lies the Union of South Africa and Rhodesia; on the north is Tanganyika (formerly German East Africa, but surrendered to the British in November, 1919). Mozambique has 297,731 square miles, and a population (1940) of 5,085,630.

Our best wishes go to *Radio Club of Mozambique* and *Lourenco Marques Radio* for continued successful broadcasting.

* * *

Radio Organizations

At my request, Arne Skoog, Stockholm, head of the *International League of Short-Wave Editors*, has compiled this interesting data on European radio agencies:

"I.N.R. stands for Institut National Belge de Radiodiffusion, that is, the Belgian National Broadcasting Corporation, which broadcasts also on short-wave via OTC, Leopoldville, Belgian Congo; many OTC programs are produced and recorded in Brussels, headquarters of I.N.R., but news, musical programs, and 'Amongst Friends' are produced in Leopoldville.

"The I.N.R., with headquarters at 18, Place Eugene Flagey, Brussels, is a large and modern radio house, consists of a French and a Flemish section (N.I.R.), and also 'Service Mondiale,' which organizes the short-wave programs; head of that Service is Frans Zoete, and director of the station in Leopoldville is Leopold Le Roye.

"O.I.R. stands for Organization Internationale de Radiodiffusion, which has moved to Prague and which now has *only* 'Eastern Powers' as members.

"U.I.R. stands for Union Internationale de Radiodiffusion, a prewar organization in Geneva; the Technical Center in Brussels belongs to a separate company but was then operated by the U.I.R. and later by the O.I.R.

"Now, the 'Western Powers' of Europe—including Sweden—have formed a new organization—O.E.R., that is,

(*Continued on page* 132)

This neat, attractive listening post, belonging to John J. Oskay, ex-W2BIZ of New Jersey, is the answer to many a DX-er's dream. The equipment, from left to right, includes a Hallicrafters S-40A receiver, a Meissner Model 9-1076 crystal frequency standard for 10, 50, and 100 kc., a Cardwell BC-221Q frequency meter with a range of from 125 to 40,000 kc., a Hallicrafters SX-71 receiver, with an RME DB-22A preselector.

(Note: Unless otherwise indicated, all time is expressed in American EST, add 5 hours for GCT. "News" refers to newscasts in the English language. In order to avoid confusion, the 24 hour clock has been used in designating the times of broadcasts. The hours from midnight until noon are shown as 0000 to 1200 while from 1 P.M. to midnight are shown as 1300 to 2400.)

The symbol "V" following a listed frequency indicates "varying." The station may operate either above or below the frequency given.

TROUBLESHOOTING CHART for the NEW HAM

By
CHARLES J. HERZER,
W2CEP

No "cure-all" claims are made for this tabulation but it is a handy thing to have around the shack.

ONE of the greatest adventures in ham radio is planning and constructing your first transmitter. After carefully searching through handbooks and back issues of radio magazines, the rig which most nearly fits the purpose is selected. After many hours of construction the little pride-and-joy is ready to put on the air. (We hope!) The wiring is carefully checked and for the umteenth time we read again the paragraph, in the article describing our rig, entitled "Adjustment." We are assured that there is nothing unusual about the rig and with ordinary precautions and adjustment it should work, etc., etc. Hopefully, we look for what is meant by "usual" and "ordinary."

After stalling around and wading through a lot of deep technical stuff, which we suppose some day we may understand, we begin to realize that the electrode voltages and the power output can vary in a bewildering number of ways. The big problem is what to measure, how should it read and, if it doesn't read properly, what's wrong and what can be done about it. What we need is a troubleshooting chart like those they have in the television service manuals whereby a person with limited knowledge can accomplish a lot.

Well, chum, here's your chart. It makes no claim to cure all of your ills but it's a start anyway. It assumes that you have the normal amount of horse-sense and a means of measuring the voltage and current to each electrode; namely: plate, screen, and grid. It is not possible to make up a chart

(*Continued on page* 106)

Listing of some of the most common transmitter faults along with the probable causes and method for correcting them.

TROUBLE	CAUSE	REMEDY
Small or no dip in the plate current as the plate tank circuit is tuned through resonance.	1. No excitation.	1. Plug in a crystal. Check for output from the driver by noticing if there is grid current on the amplifier without high voltage applied to the amplifier.
	2. Amplifier input tank not tuned to resonance.	2. Tune for maximum (but not over-rated) grid current. This should occur at the dip in the driver plate current.
	3. Overload of the stage due to parasitic oscillation.	3. A probable cause may be low frequency parasitics caused by the use of r.f. chokes in both the input and output. Use series feed in the output.
	4. Too tightly coupled load.	4. Ease off the coupling of the load to find the dip while tuning. (Pentodes can't stand high off-resonance inputs for long.)
Double resonance in the plate tank circuit. There is one setting of the condenser for dip in the plate current and another slightly off for maximum output.	1. Poor voltage regulation. With a series screen-dropping resistor the maximum screen current and the minimum screen voltage occur at the dip in plate voltage. Since the power output is controlled by the screen voltage, slightly more power output may be obtained with more plate current by detuning the tank and thus giving higher screen voltage.	1. If the supply voltage is so high that a high value of screen dropping resistor (in excess of that recommended) is needed to get the rated screen voltage, use a system of regulated screen supply.
	2. Too little capacity in the output tank circuit.	2. Take off one or more turns from the coil so that resonance is obtained using more of the condenser. Use a "Q" of 12 or more.
	3. Insufficient excitation.	3. Get the recommended grid current at the proper bias for the type of emission used.
Plate and screen current soar to excess when excitation is removed.	This is normal with grid leak bias used without some additional protective bias.	Unless you enjoy replacing tubes put in either a moderate cathode resistor (bypassed), bias battery, etc., which need give only enough bias to prevent destruction of the tube should excitation fail. With no excitation ALL of the input is dissipated as heat within the tube.
With excitation removed (and reduced plate and screen voltages) there are variations in the plate current as the plate tank is tuned over the entire range. Try this for various settings of the input condenser.	V.h.f. parasitics. Note: There may be other v.h.f. parasitic circuits external to and not shown by tuning of the tank circuits so this is not a complete test for parasitics.	Use a v.h.f. choke right at the plate terminal of the tube. (10 to 15 turns or so of No. 20 on a $\frac{1}{4}$ inch dia. high value carbon resistor.) Use 50-ohm carbon resistor at the screen and grid pins and, most important of all, use a common point for bypassing to ground.
Cannot reduce the plate current to zero using the rated cut-off bias.	1. Very poor voltage regulation in the power supply. 2. Plate or screen fed through series dropping resistors.	1. Use choke input power supply with a low-resistance choke. 2. Use more bias up to the point where you do not exceed the rated value under operation.
	3. Bias obtained through use of a cathode resistor. In this case there must be some current in order to get a voltage across the resistor.	3. Use a separate bias supply.

TROUBLE	CAUSE	REMEDY
Difficulty in coupling power out of the plate tank. High harmonic output.	Too much inductance and not enough capacitance in the tank circuit.	Take a turn or so off of the coil to get an L-C ratio which will give a "Q" of 12 or more as explained in handbooks.
Plate current spontaneously rises, especially if the tube is operated at higher than rated grid or plate dissipation. The tube "runs away with itself."	The grid got hot enough to emit electrons and overcame the bias which only made it hotter.	The tube is usually ruined. Keep within rated values while tuning up and while in operation.
High unloaded plate current at the dip.	With high-C tank circuits as occur with high-output screen tubes on high frequencies (such as using a 10 meter coil on 20) there are high currents circulating in the unloaded tank.	When delivering power to a load these losses decrease and are not serious. Make sure this is the case by checking the power output. Use an L-C ratio for a "Q" of 12 or more.
Poor performance as a frequency doubler or multiplier.	1. Insufficient excitation. 2. Insufficient bias. 3. High C and low L tank circuit.	1. The efficiency of multipliers is less than straight-through operation and more drive is required if the same output is expected. 2. High values of negative bias distort the wave-shape and create harmonics (in this case desirable). 3. A high L and low C tank is best for harmonic generation.
Excess screen current.	1. Excess excitation. 2. Light or no load on the stage. This results in a large plate-voltage swing and with low voltage on the plate the electrons are attracted to the screen. 3. Excess screen voltage.	1. Use no more excitation than necessary to give rated output at rated bias. With a series screen-dropping resistor, an increase in excitation beyond a certain point will actually result in a decrease in output. 2. Increase the load to optimum and do not operate the tube without load except for short tests. Do not load much beyond the point where further loading does not affect the screen current as this only increases the plate dissipation. (The plate current rises, true, but not the power output.) 3. If the screen voltage must be higher than rated in order to get the rated plate current check the bias and excitation and keep within rated values.
When load is applied the grid current drops excessively.	1. Insufficient excitation. 2. Excess bias.	1. Adjust coupling to driver or increase input to the driver. (If the driver is a pentode remember that the output is controlled by the screen voltage more so than the plate voltage.) 2. Use the rated value for the type of emission.
Low rectified grid current in the driven stage with normal input power to the driver (measured with no plate voltage on the driven stage).	1. Amplifier input tank not tuned. 2. When capacity coupling is in use between stages there is too much or too little used. 3. The impedance of the driven grid circuit is much different from the impedance of the driver plate circuit. 4. Not enough driver power.	1. Use proper constants. If the driver is also a harmonic generator favor a high L and low C circuit, taking into account also the inductance of the leads and the capacitance of the tubes. The tube capacities involved are the output capacity of the driver and the input capacity of the amplifier. 2. Usually, increasing the capacity increases the load on the driver but the reverse may also give increased output. 3. With a single-ended input tank and a grid impedance higher than the driver plate impedance, tap the driver plate down on the coil. If the reverse impedances are in effect tap the grid down. 4. Use a bigger driver.
The grid current in a battery-biased stage falls off after a period of operation. The bias battery still shows normal or better voltage.	The internal resistance of the battery is high due to age (in spite of its voltage).	Replace the battery with a fresh one.
Wrong value of bias voltage from a bias supply using a gaseous V-R tube.	If the glow is from the central cathode the tube is in the circuit wrong. The glow must be from the inner surface of the plate.	Reverse the connections to the tube. Remember, in this case the chassis is at the positive potential.
Insufficient bias as measured from the cold end of the grid choke to the chassis with grid leak plus cathode bias.	Wrong way to measure the bias in this case.	The bias is the total voltage developed across the grid leak and the cathode resistor. Add the sum of the drops across these resistors while the rig is loaded.
When the plate tank is tuned slightly to the high-frequency side of resonance there is a sudden increase in output power and grid current.	Self-oscillation due to improper neutralization.	Isolate input and output circuits. Shield the lower portion of the tube. Neutralize.
Impossible to neutralize the stage at any setting of the neutralizing condenser.	Chances are with tubes which have a low grid-to-plate capacitance (such as 6L6) the wiring itself introduces enough capacity so that the neutralizing condenser "over neutralizes."	Isolate the input from the output and use short leads. Use inductive or link neutralization.
Impossible to maintain exact neutralization except at resonance (usually with a split-stator condenser and small capacity).	With tubes of high output capacity the stray circuit capacities have more influence over the balance of the circuit than the capacity of the tank.	Use a coil of such inductance that a reasonable amount of condenser is used. Don't try to operate too many bands with one coil.
With no plate current applied there are variations of the rectified grid current as the output tank condenser is tuned.	This is a very good test for incomplete neutralization.	Neutralize.
Can reduce the r.f. in the plate tank circuit by neutralizing but cannot eliminate it.	Magnetic or capacity coupling between the input and output of the tube which is external to the tube.	Mount the input and output coils with their axes at right angles to each other. Shield the input from the output. As a test, disconnect the output plate tank from tube and if r.f. persists it is due to magnetic coupling.
Key clicks not traceable to the actual keyed stage or keying constants.	Instability in the amplifier caused by tendency toward self oscillation or parasitics. Even though the stage has nothing to do with the keying it must be remembered that the electrode voltages and currents vary over a wide range in the short interval on make and break.	Have the amplifier completely neutralized and take the required steps to eliminate parasitics. When a stage ahead of the amplifier is keyed the amplifier should be biased so that the plate current is nearly, but not completely, cut-off in the "key-up" condition.
High harmonic output.	1. Low "Q" grid tank. 2. Capacity coupling (which makes no discrimination between fundamental and harmonic). 3. Over excitation. 4. Excess bias.	1. Use a "Q" of 12 or so. 2. Use link coupling and, if necessary, a shielded link or a Faraday screen. 3 & 4. Use rated grid current at the rated bias for the type of emission.

TV Servicing With GRID-DIP OSCILLATOR

By
WALTER S. ROGERS,
W1DFS

Fig. 1. The i.f. coils can be checked with set turned off.

Every technician has his own pet servicing procedure. Here is one system—the GDO which has been used by many of the "old timers." Like any other method it has its pro's and con's.

WHEN television really hit the consumer market many an "old timer" in the radio game gave up hope of ever being able to service these receivers after studying the accompanying schematics and investigating the "engineering" servicing techniques required. The new and seemingly involved test instruments, the unfamiliar circuit designations, and the complicated test patterns all combined to discourage the technician whose life up to that time had been devoted to repairing relatively uninvolved a.c.-d.c. midgets and straightforward consoles. Some of these service technicians spent time and money taking courses in servicing television receivers, others gave it up as a bad job. To the newcomer it looked very much as if television servicing would require a PhD, and a laboratory full of costly instruments new to radio servicing.

Many of the fellows in the radio service profession got along with the service manuals, a voltohmmeter, and a simple signal generator. Experience counted. One line of sets had coupling condenser trouble. In damp locations another model receiver needed to have the electrolytics replaced each year. The author spent one summer "curing" set ills with only a six volt voltmeter, a few batteries, and a defective signal generator as test "equipment." To be sure this test setup took more time for complicated repairs but the simplicity of the equipment notwithstanding, it was easy to determine what end of the set needed attention first.

One old-time radio technician followed a servicing technique similar to the author's. He worked from the back end of the set forward. After giving the set an "aural" check and if the receiver wasn't in smoke, a few voltages were checked and the tubes given a once-over. Then he would look for signs of audio by touching the grid of the audio tubes with the 6 volt and battery gadget which was being used as a circuit tester. If there was no response, then it was time to check the speaker, voice coil, transformer, and tube circuits. Most sets were of the field-excited speaker type, thus the magnetic pull on a steel tool gave a rough check. Next followed a check of the detector and so on to the antenna end of the set itself until the trouble was located and corrected. This back-to-front radio servicing sequence is a familiar one to the old timers in the radio servicing game.

Now television servicing can be tackled in much the same way by the use of a *good* grid dip oscillator. The author is using a *Millen* No. 90651 unit for his servicing work. Most service technicians consider a grid dip oscillator as a laboratory tool of use only in communication and research work. Actually a grid dip oscillator, which costs no more than a good tube tester, can be worth its weight in gold in television servicing work.

Several months ago the author started gathering data on the use of a grid dip oscillator in TV servicing. A few of the video service technicians known to the author were using the grid dip oscillator but they had run across this application for the instrument accidentally or as a result of having the unit called to their attention by friends. As the material accumulated, new applications and better techniques were found, thus the suggestions embodied in this article form a mere nucleus of possible methods for simplified TV servicing.

The *Millen* No. 90651 grid dip oscillator used by the author is a convenient unit which may be held and tuned one-handed and covers the range from 300 mc. to 1.7 mc. It has an isolated power supply and the controls are such that it is ideally suited for TV servicing applications (see Fig. 4). New coils have been announced which will extend the low frequency range to 225 kc., thus carrying the usefulness of the instrument into the AM servicing field.

A grid dip oscillator is nothing more than a small oscillator which covers the desired frequencies and has a sensitive meter in series with the grid circuit. This grid meter dips positively when the oscillator coil is closely coupled to another coil tuned to the same frequency. The small amount of power absorbed from the oscillator circuit excites the grid less and thus reflects a drop in grid current when coupled to a circuit resonant to the same frequency. While this sounds simple, to build a unit free from false indications and then calibrate it is a real job. The case must be solidly bonded and have no casual joints, otherwise the instrument will be subject to all sorts of erratic results. The calibrated scale on a commercially-built unit is spread on a drum dial so that it can be easily read. The standard unit in the author's possession has been checked at several points and was well within the 2 or 3 per-cent required. The addition of the telephone jack, as shown in Fig. 2, makes adequate provision for the introduction of supply modulation needed in television servicing. While the designers of the in-

strument probably didn't have that particular application in mind it has proven very handy for television work.

TV Servicing Procedure

In order to check the practicality of the instrument before preparing this article, several television technicians were asked to use the grid dip oscillator on their regular servicing calls. One of these men was an old hand at the game, another was a beginner who had only recently graduated from radio school and was making his first appearance as a "professional," while others in the group had military radar or television servicing backgrounds.

It is not the author's contention that any "dope" can service a complicated television set on the first try providing he is equipped with a grid dip oscillator. However, a relatively unskilled person who has received proper instructions *can* line up an intentionally misaligned set so that it will produce a good picture and it is a much simpler procedure than that needed with an oscilloscope. In fact, two sets which didn't yield to oscilloscope figure techniques were aligned quickly when the proper grid dip oscillator techniques were applied. One set being checked had i.f. coils at one-half frequency while another standard make, for some reason, came through with the i.f. at twice the frequency. With the aid of the instrument, it was a simple matter to trim or pad to bring the i.f.'s in line.

In servicing the set, first start with a few voltage checks. See that all the tubes are lighted (or warm—most TV tubes are the small glass miniatures). Look for the raster on the tube. Chances are that the cathode-ray tube is getting voltage when the screen shows life. What can be seen and heard at this stage provides a fair indication of the possible source of trouble. Now is the time to use the grid dip oscillator.

Select a coil for the video range (21 or 37 mc., etc.), put terminals on a phone plug so that leads can be run to an audio oscillator. While a *Hewlett-Packard* modified 200B, rated at one-quarter of a watt at 500 ohms output, was used in this application, a home-built oscillator can be used providing it has a volume control and covers the 500 to 1000 cycle range. Turn on the grid dip oscillator and then tune it to the video frequency. Turn on the audio oscillator which should be set at about 780 cycles and about half gain. If the video and sweep circuits are functioning at all a horizontal line pattern similar to that shown in Fig. 3 will appear. This figure and the vertical bars, with a frequency run on the audio oscillator, are the key—using the horizontal video first and audio, then working to the front end before trying the vertical. The vertical needs the r.f. amplifier as the grid dip oscillator output without some direct wire connections, which are to be avoided, is not powerful enough to show vertical lines by radiation pickup at the video

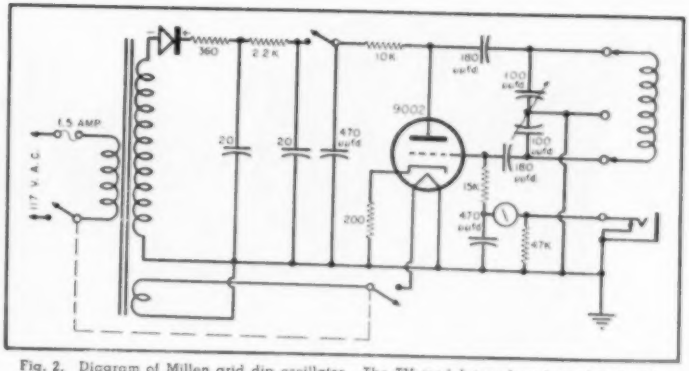


Fig. 2. Diagram of Millen grid dip oscillator. The TV modulator plugs into phone jack.

frequencies. Thus, the sequence suggested should be followed until the use of the grid dip oscillator in TV servicing becomes second nature.

Servicing Applications

Based on the results of several practical service applications, the grid dip oscillator is best used to isolate the trouble sections of the receiver and then to function as a test unit for the individual components which could be causing the trouble. There is no standard procedure to be followed except to work first from the video for horizontal bars and then checking the audio itself, in detail, if need be, with the traps, sweep circuits, linearity, discriminator, speaker, etc. With an adequate audio signal generator, a complete response run may be made. It is important that the grid dip oscillator is not overloaded as the signal will be frequency modulated so severely that it will not be representative of a standard signal.

Using the video frequency with the 780 cycle audio modulation, the service technician should obtain the horizontal lines as shown in Fig. 3. There will be a good chance to check focus, contrast, and vertical linearity with the grid dip oscillator set at the center of the video i.f. The audio is checked by moving to the higher frequency end of the i.f. where the traps, needed to keep the sound from reaching the picture circuits, can be checked.

One of the most cogent reasons for using the grid dip oscillator for troubleshooting, according to the service technicians who have been using it, was that the condensers, coils, oscillating or non-oscillating circuits could be checked rapidly whether the receiver was on or off. With the proper coil and the grid dip oscillator used as instructed in the manual, the actual servicing took less time than the setting up of the more complicated pattern checking equipment previously used.

With what appears to be normal operation from the back of the set, adjust the grid dip oscillator to an r.f. channel and disconnect the antenna. The *Millen* unit used by the author gave plenty of drive a few feet from the front end of the TV receiver, except in instances where the receiver was *very* dead. The instrument may be used as the receiver oscillator when the modulation is cut off. The oscillator frequency and operation can also be checked by turning off the plate current of the grid dip oscillator and with the phone plug removed so that it operates as a sensitive absorption wavemeter, it will indicate whether or not the set's oscillator is operating properly.

A further use of the unit is suggested by Fig. 1, where the i.f. coils are checked to see that they are aligned to the fundamental. By probing from coil to coil it is possible to check whether there is a normal increase in

(*Continued on page* 177)

Fig. 3. Horizontal test bars as they appear on TV screen. Absence of vertical bars in later tests indicate vertical sweep defect.

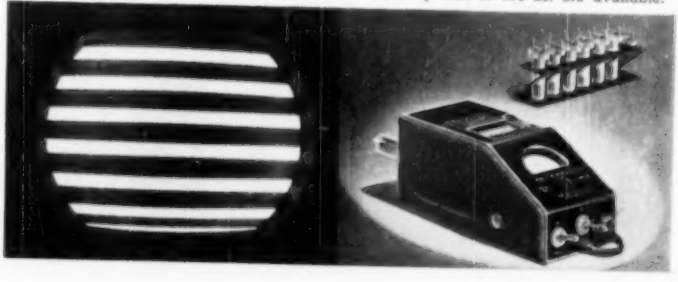


Fig. 4. The Millen No. 90651 grid dip oscillator which covers from 1.7 to 300 mc. Low frequency coils to 225 kc. are available.

Fig. 1. Over-all view of amplifier. Power supply is built on a separate chassis.

A Wide-Range FEEDBACK AMPLIFIER

Inverse feedback over 4 stages proved no problem to author in designing this American version of the "Williamson Amplifier."

By

ROBERT M. MITCHELL

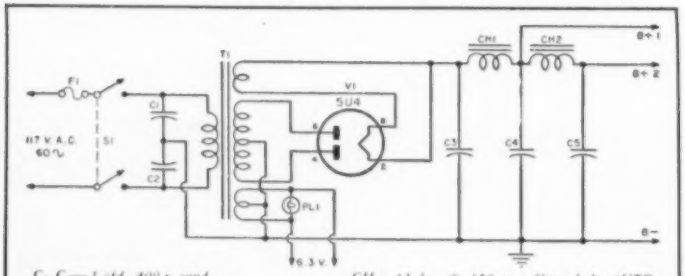
Circuit Application Engineer, United Transformer Co.

THE growing demand for increased realism in the reproduction of sound, both in music and speech, has necessitated a reconsideration of several basic problems in the design of audio amplification equipment. These problems are concerned with psychological as well as physical phenomena, and involve such varied considerations as system bandwidth, room acoustics, the sensation of loudness, and the relationship between distortion products and musical dissonance, to name only a few. In this continued striving for more faithful reproduction, negative feedback plays an indispensable part.

At one time negative feedback was used somewhat as a remedy, that is, it ameliorated gross defects in equipment of mediocre quality until some of the resultant specifications were comparable to those of higher quality equipment. Fortunately for the music-lover, those days are largely past, and feedback is now more profitably employed in refining the characteristics of an already superior system. Thus, it is becoming more common to find large amounts of feedback being used with medium-power, all-triode amplifiers of very linear characteristics, employing parts of the highest quality. The employment of such large amounts of feedback requires that, for stability's sake alone, the gain-frequency and phase-frequency characteristics of the original amplifier be controlled over a range much greater than that over which the benefits of the feedback are desired. Terman, in his "Radio Engineers Handbook," page 226, gives as an approximate rule the relation of one octave extension of range for every 10 db. of feedback desired, plus one or two octaves as a margin of safety. Thus, if it is desired to produce an amplifier with 20 db. of feedback and a useful range of 20 to 20,000 cycles, it is necessary that the characteristics of the feedback loop be controlled for at least three octaves beyond this range, or from 2.5 cycles to 160,000 cycles. Since the control of gain characteristics is a comparatively simple matter for resistive-capacitive coupled stages, the crucial component in a high-quality amplifier is the output transformer.

A high-quality amplifier of excellent linearity and utilizing 20 db. of feedback around all four stages and the output transformer has recently

Fig. 2. Schematic diagram and parts list covering the amplifier power supply.



C_1, C_2—.1 μfd., 400 v. cond.
C_3, C_4, C_5—8 μfd., 600 v. elec. cond.
T_1—Power trans. 400-0-400 v. @ 200 ma.; 5 v. @ 3 amps.; 6.3 v. @ 6 amps. c.t. (UTC R-113)
PL_1—6.3 v. pilot light
CH_1—12 hy. @ 150 ma. filter choke (UTC CG-100)
CH_2—75 hy. @ 50 ma. filter choke (UTC CG-48C)
S_1—D.p.s.t. sw.
F_1—3 amp. fuse
V_1—5R4GY or 5U4G tube (See text)

been developed in England by Mr. D. T. N. Williamson. This "Williamson" amplifier was literally designed around a special output transformer, and used standard English parts. It is the purpose of this article to describe an outstanding version of this amplifier which uses a stock output transformer and standard American parts.

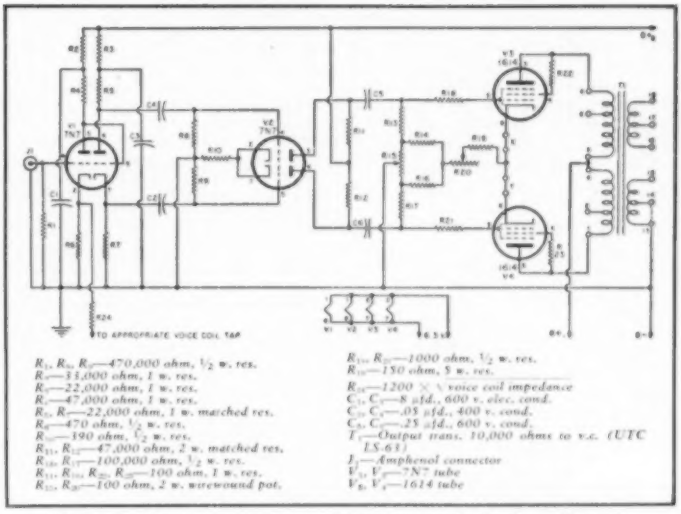
The heart of the amplifier is the output transformer, *UTC* LS-63. This transformer matches push-pull loads of 10,000 and 6000 ohms to a wide range of voice coil impedances. The frequency response of the transformer alone extends smoothly within 1 db. from 15 cycles to 50 kc. at medium power levels. This response enables the entire amplifier to be incorporated in the feedback loop with complete freedom from instability. The resulting feedback amplifier has a frequency characteristic which is flat within 1 db. from 10 cycles to 100 kc.!

The amplifier circuit is straightforward and simple. As may be seen from Fig. 3, it consists of four stages; a voltage amplifier, direct-coupled to a split-load phase inverter, a push-pull voltage amplifier, and a push-pull power amplifier stage. The output tubes are 1614's, connected as triodes, with self bias. Except for a lower maximum plate voltage rating, this tube is electrically identical to the 807, but has the additional advantages of being single-ended in construction and having a standard octal base.

In order to permit flexibility of operation, the amplifier was built on two chassis, one containing the amplifier proper, and the other the power supply. Figs. 1 and 5 show the top-chassis and under-chassis views respectively of the two units. Point-to-point wiring is used throughout, with short, rigid leads and a common ground bus serving to reduce stray coupling and hum pickup. The ground bus picks up the individual grounds in order, starting at the highest level stages and progressing in order to the lower stages, where it is finally grounded to the chassis at the input.

The performance of the amplifier depends to a large extent on the balance of the push-pull stages. The output transformer constants (inductance, leakage, etc.) are precision-balanced, so that no adjustments are needed for that component. The plate load resistors for the push-pull driver stage should be matched, as should also the plate and cathode resistors in the phase inverter stage. Before the amplifier is placed in operation, two simple adjustments must be made. These adjustments set the operating conditions for the output stage, and normally need be made only once.

Since the total plate dissipation for the two 1614's is 50 watts, the total cathode current must be limited to 120 milliamperes. This is accomplished by inserting a milliammeter in the common leg and adjusting R_{26}. This will produce a bias of about 38 volts when the plate to ground voltage is 440 volts, and will keep the static plate



R_1, R_{20}, R_{21}—470,000 ohm, ½ w. res.
R_2—33,000 ohm, 1 w. res.
R_3—22,000 ohm, 1 w. res.
R_4—47,000 ohm, 1 w. res.
R_5, R—22,000 ohm, 1 w. matched res.
R_6—470 ohm, ½ w. res.
R_{7a}—390 ohm, ½ w. res.
R_{11}, R_{12}—47,000 ohm, 2 w. matched res.
R_{13a}, R_{13b}—100,000 ohm, ½ w. res.
R_{14}, R_{15}, R_{22}, R_{23}—100 ohm, 1 w. res.
R_{25}, R_{26}—100 ohm, 2 w. wirewound pot.
R_{27}, R_{28}—1000 ohm, ½ w. res.
R_{29}—150 ohm, 5 w. res.
R_{24}—1200 Ω ± ½ voice coil impedance
C_1, C_2—8 μfd., 600 v. elec. cond.
C_{3a}, C_4—.05 μfd., 400 v. cond.
C_5, C_6—.25 μfd., 600 v. cond.
T_1—Output trans. 10,000 ohms to v.c. (*UTC* LS-63)
J_1—Amphenol connector
V_1, V_2—7N7 tube
V_3, V_4—1614 tube

Fig. 3. Complete schematic diagram of the wide-range feedback amplifier unit.

dissipation within the 50 watt rating. After this is done, the standing currents in each tube are adjusted to equality by placing milliammeters at points *X* and *Y*, and adjusting R_{13a}. This adjustment reduces the unbalanced d.c. current in the output transformer primary, and, consequently, improves the low frequency response.

When adjusted according to the above instructions, the amplifier is operating almost completely in Class A, and will deliver 8 watts of power with almost undetectable distortion (less than 0.1%). Although this may seem to be a rather low power output, it is more than adequate for home listening. For reproduced music to sound at

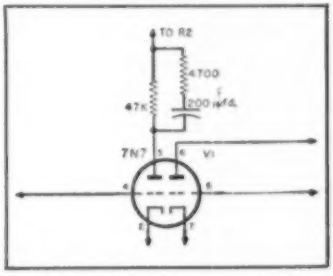
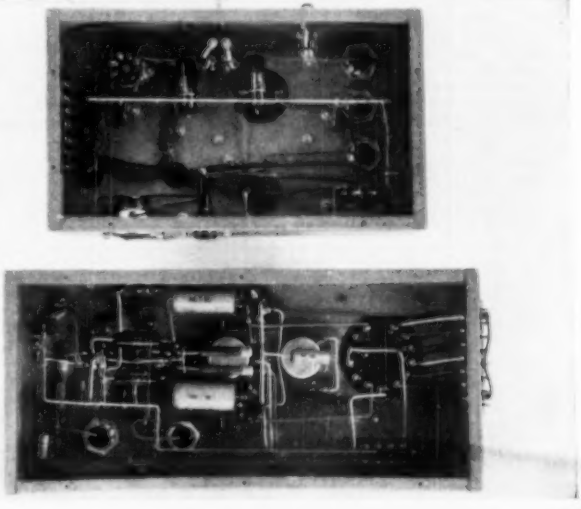


Fig. 4. Phase correcting network which can be used to eliminate the effects of excessive stray capacity or capacitive loads.

Fig. 5. Under chassis views of the audio amplifier and accompanying power supply.



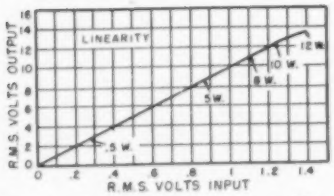


Fig. 6. Linearity curve of the amplifier.

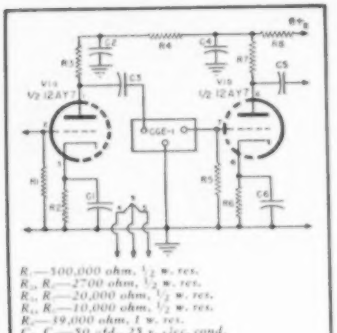


Fig. 7. An equalizing circuit, giving up to 15 db. boost or cut at either end of the spectrum, which may be used with amplifier.

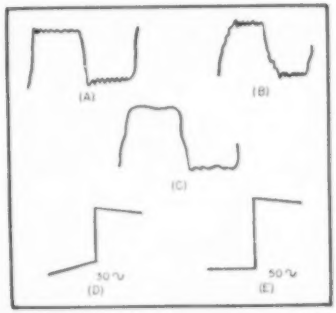


Fig. 8. Frequency response of the amplifier. See text for an explanation of waveforms.

about concert level to the listener in a large-sized living-room requires an average of about 5 milliwatts of acoustic power. In a fair-sized living-room of say, 2500 cubic feet volume, a value half this great is adequate. Allowing an average of 20 db. (100 times as much power) for peaks, a value of 0.25 watts is obtained. To produce this acoustic power through a speaker system of 10% efficiency requires an electrical power of 2.5 watts. Under these condition the 8 watt amplifier has a safety margin of undistorted power of more than 3 times, or 5 db. If more power is required, the bias may be changed so as to operate the output stage more in Class AB_1 by adjusting R_{bb} for 110 ma. total current (approximately — 40 volts bias), and adjusting R_{aa} for equal currents as before. Under these conditions the distortion is 0.3% at 10 watts and 1% at 12 watts.

In the English design, a phase correcting network across R_1 is a permanent part of the amplifier. This tends to increase the margin of stability at high frequencies. The leakage inductance of the *UTC* LS-63 is so low that this network is ordinarily not required. However, if the secondary load is highly capacitive or other stray capacities are introduced in the amplifier, it may be desirable to add this network. If the output tube currents are high when all components are properly connected and all other measurements are correct, it is usually an indication that the circuit is oscillating at a very high frequency due to the stray capacities mentioned above. In such cases, the phase correcting network shown in Fig. 4 will eliminate this.

The power provided by the power transformer and that dissipated by the output tubes in particular is considerably larger than in most home amplifiers. Consequently, the constructor must allow for adequate ventilation when mounting the unit in cabinets, etc.

If the "B+" voltage is too high, because of high line voltage, for example, the 5R4GY tube (Fig. 2) should be used in place of the 5U4G. This tube may be plugged directly in the same socket, since the basing is identical, and due to its larger internal drop, will give a lower output voltage.

The performance characteristics of this amplifier are illustrated in tabular and graphic form in Figs. 6, 8, and 9. All of the measurements were made with a source resistance of 50,000 ohms and a non-inductive resistor of 15 ohms connected to the 15 ohm secondary terminals of the output transformer.

Fig. 9A shows the frequency response at different output levels for Class A operation, while Fig. 9B shows the response for Class AB_1 operation at higher levels. The response of the amplifier with 40 volts bias is essentially the same at low levels as that of Fig. 9A. The linearity of the amplifier over the entire power range is shown in Fig. 6.

The low distortion content of this amplifier is outstanding. At 8 watts (actual measured power dissipated in the load resistor, not an "equivalent power") the distortion is less than one-tenth of one per-cent. Because the distortion is so minute, it is necessary that several precautions be taken in measuring it, in order to insure that spurious voltages such as noise, hum, etc. are not included in the results. The author has found that a satisfactory procedure is to pass the audio generator output through a low-pass filter of at least 60 db. attenuation and measure the harmonic components of the amplifier output with a wave analyzer.

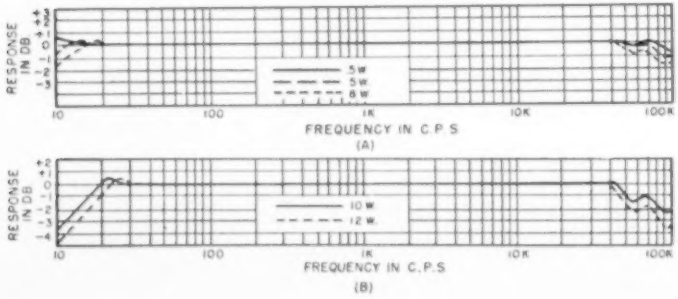
One of the desirable features of audio amplifiers is low output impedance, and in this respect a negative feedback amplifier is unsurpassed. The ratio of the load resistance to the effective output impedance is called the damping factor, since it determines the effectiveness of the amplifier in damping vibrations originating in the loudspeaker.

A common value of damping factor for beam tubes with feedback or triodes without feedback is 3. The damping factor of this amplifier is 27, equivalent to an output impedance of 0.55 ohm at the 15 ohm secondary. This ability of the amplifer to damp the loudspeaker contributes substantially to the "cleanness" of reproduction.

Another factor contributing to clarity in reproduction is the transient response. Because of the ease of interpretation involved, transient response is usually tested by means of square waves. The high frequency square wave response of the amplifier is shown in Fig. 8. In this diagram (*A*) represents the response of the entire amplifier to a square wave of 10 kc. repetition rate. The rapidity with which the maximum value is attained, *i.e.*, the short rise time, is a graphic indication of the extremely small leakage inductance and stray capacitance of the output transformer. For comparison purposes the high frequency square wave response of a poorly designed unit is shown in Fig. 8B.

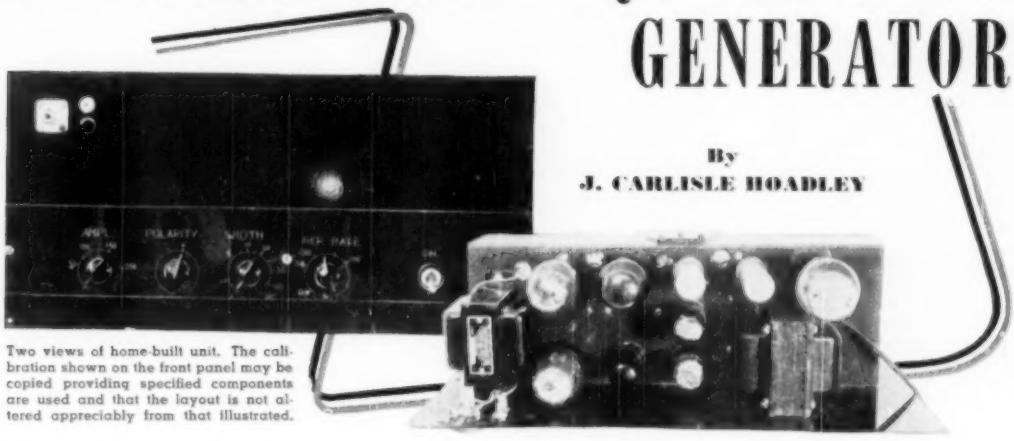
(*Continued on page* 166)

Fig. 9. (A) Frequency response at different output levels for Class A operation, and (B) the frequency response of the amplifier in Class AB, operation at higher levels.



A Variable Width SQUARE-WAVE GENERATOR

By
J. CARLISLE HOADLEY



Two views of home-built unit. The calibration shown on the front panel may be copied providing specified components are used and that the layout is not altered appreciably from that illustrated.

Details on a generator unit whose pulses can be varied from 1 to 140 microseconds in width with a repetition rate of 60 to 600 cycles-per-sec.

ONE of the most frequently used instruments to be found in the electronic laboratory is a square-wave generator, which combines a multiplicity of outputs with versatility of operation. The construction of this very useful piece of equipment is covered in this article.

It is, essentially, a square-wave generator together with amplifiers, inverters, and an output stage. The block diagram in Fig. 1 gives the setup. The object is to produce a square wave which rises as nearly vertically as possible, has a flat top for a desired length of time, and then cuts off as fast as possible. In many instances it is desirable to vary the duration of this square wave, i.e., the length of the "top," and it is evident that if the front and back are not steep the duration of the top is not distinct. It is, of course, impossible to produce a square wave with vertical sides, as that would mean a voltage rising to a given value in an infinitely small period of time. This might be done if it were not for the fact that all circuits have inherent capacities, and these capacities must be charged while the voltage is rising. Of course, the time necessary to charge a capacity is a function of its size. It would seem, then, that the important item in building a square-wave generator would be the reduction of all important capacities.

As a general rule, then, it is desirable to keep the circuit capacities small and use low impedance circuits. The formula which states the time necessary to charge or discharge a condenser through a resistance is, $T=RC$ where T represents the time necessary for the voltage to rise to $1-1/e$ (approximately $^2/_3$) of its maximum value or, to fall to $1/e$ (approximately $^1/_3$) of its original value, where T is stated in seconds; R, in ohms; and C in farads. More usable units would be T in microseconds; R in megohms; and C in micromicrofarads. The value of e is 2.718.

This, then, is the first consideration in building a good square-pulse generator—the reduction of all unwanted capacities.

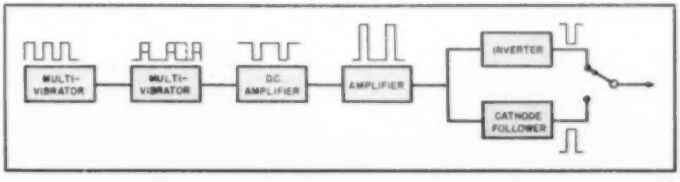
Secondly, the unit should perform several functions. It must be understood at this point that we are considering a square-wave generator of the unsymmetrical type, i.e., where the first half of each cycle is smaller (or greater) than the second half and is, moreover, variable in width, amplitude, polarity, and repetition rate.

Referring to Fig. 1, we find an ordinary symmetrical multivibrator whose function is to provide a means for frequency stabilization.

A multivibrator is not too stable a device, and since we wish to produce a square wave which is stable, maintaining any width at which it is set, it is better to synchronize the pulse generating multivibrator from another multivibrator whose sole function is to produce recurrent symmetrical square waves.

There would also be unwanted interaction between the frequency and width control if both were incorporated in one multivibrator. We have, therefore, the first multivibrator in Fig. 1. It is coupled into the second multivibrator, which is of a different type. This multivibrator is biased so that it will not operate by itself, but will remain off until a pulse of energy is received, which neutralizes the bias and allows it to flop once. It is often referred to as a flip-flop, or trigger circuit. In coupling the first multivibrator to the second, it is desirable to transfer only a very short pulse of energy so that this pulse will not in any way affect the resultant square wave. Thus, coupling is by means of a very small condenser so that the square wave from multivibrator number one is differentiated. Fig 2 illustrates this result. The small condenser charges as the square wave rises, but, being small, it discharges almost immediately. At the end of

Fig. 1. Block diagram of square-wave generator. Two multivibrator stages are used.



* Audio Sub Section Head, Radio and Communications Section, Electronics Test Division, Naval Air Test Center, Patuxent River, Maryland.

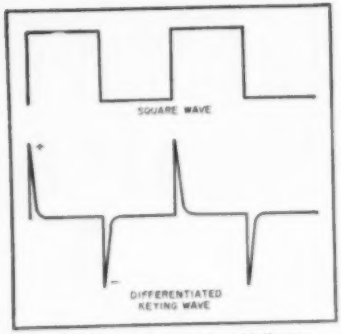


Fig. 2. Wave shapes at multivibrators.

the square wave it charges negatively, but as the tube is already cut off nothing happens.

This second multivibrator, in addition to being "biased up," is also unsymmetrical as it has a longer time constant in one grid circuit than the other. We have chosen to vary the smaller one. The most convenient way to do this is to vary the resistance rather than the capacity, as a greater range can be covered with less trouble. By varying this time constant we vary the time interval that the trigger circuit remains on after the keying circuit has keyed it on. This is due to the variable time constant which is charged by the keying pulse and discharges in the desired time to a value which shuts off the circuit.

In the interest of improving the rise and fall times of the square wave, a very small plate resistor is used in the plate of the variable width multivibrator which is to be coupled. The effect of stray capacities will then be reduced.

The pulse is now introduced into a d.c. amplifier, which operates at +150 volts plate potential. The signal voltage across the plate resistor of the multivibrator is just sufficient to drive the d.c. amplifier to zero bias, which has the effect of making the pulse flat on top and steepening the sides. This d.c. amplifier also has a low value of plate resistance so the amplitude across it will be small. Furthermore, the pulse is now negative in polarity. In order to correct this condition a resistance-coupled amplifier is introduced in order to invert the pulse and amplify its amplitude to over a hundred volts.

Considering that a good square wave contains frequency components from a few hundred cycles per second to several million cycles per second, it is easy to see why low value plate resistors and low capacity wiring is required.

The amplified square wave is now introduced into either a cathode follower if positive output is desired or into another amplifier if negative output is wanted. Since the cathode follower gives a low impedance output, a reasonable amount of capacity can be tolerated across it without distorting the pulse too much. This cathode follower has an output impedance in the order of several hundred ohms.

The tube lineup was chosen as the best compromise between good operation and current drain.

The two 6SN7 multivibrator tubes will provide square waves which are very good, and the 6AG7 d.c. amplifier is superb for its job. In the event one is not obtainable a 6V6 could be used. The 6Y6's are the best tubes for the amplifiers because they provide very low impedance. They, of course, draw considerable current.

The circuit diagram is shown in Fig. 3 and several things should be noted. L_1 is a small r.f. choke which can be made by winding a hundred turns or so of #36 wire around a 1 megohm, one watt resistor.

The heater supply for the 6AG7 should be separate as its cathode operates 150 volts above ground. The 3000 ohm variable resistance in the cathode of V_3 makes it possible to vary the output from zero to the maximum value.

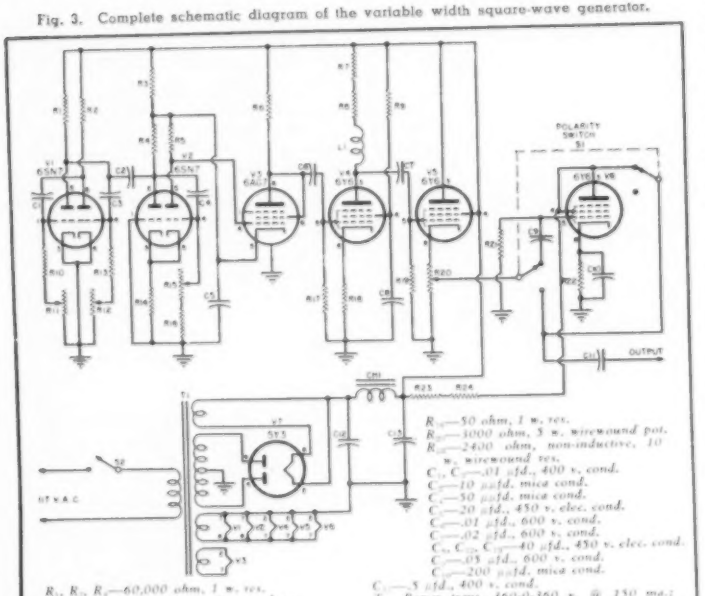
The layout used by the author should be followed carefully, although the size and shape of the chassis can be changed. All signal leads *must be short*, and kept away from the chassis. The chassis must not be used as a ground connection. A heavy copper ground bus should be used.

The ten watt resistors used in the unit should be mounted so that they have plenty of ventilation, as they will get rather hot. The output is taken from binding posts on the front panel, and a coaxial connector is provided in the event that the pulse is wanted at some distance from the unit. All the small parts should be wired point-to-point with their leads kept as short as possible. Since we are dealing with frequency components in the order of several megacycles, the leads must be short. The ground circuits should be wired exactly as shown in the diagram. Each tube's cathode should go directly to ground, and the grid and plate returns for that tube should be connected to that ground only.

After the unit is wired an oscilloscope will be needed in order to check its operation. An ordinary scope is not suitable for the observation of these variable width square pulses, as the sweep circuit does not usually go high enough in frequency, and the accelerating voltage on the cathode-ray tube's anode is not high enough to give good brilliancy on a pulse which is on, for instance, for one millionth of a second, sixty times per second. The proper scope to use is one whose sweep is ultra fast and which is, in addition, keyed on by the front of the square wave being observed.

Many good scope designs were evolved in the radar laboratories dur-

Fig. 3. Complete schematic diagram of the variable width square-wave generator.



R_1, R_2, R_4—60,000 ohm, 1 w. res.
R_3—10,000 ohm, 10 w. wirewound res.
R_5—650 ohm, 1 w. res.
R_6—1000 ohm, 1 w. res.
R_7, R_8, R_{20}—2000 ohm, non-inductive, 10 w. wirewound res.
R_9—15,000 ohm, 10 w. res.
R_{10}, R_{13}—27,000 ohm, ½ w. res.
R_{11}, R_{12}—Dual 500,000 ohm pot.
R_{14}, R_{15}—5000 ohm, 1 w. res.
R_{16}—1 megohm pot.
R_{17}—4000 ohm, ½ w. res.
R_{18}, R_{19}—470,000 ohm, ½ w. res.
R_{21}—50 ohm, 1 w. res.
R_{22}—3000 ohm, 3 w. wirewound pot.
R_{23}—2400 ohm, non-inductive, 10 w. wirewound res.
C_1, C_2—.01 μfd., 400 v. cond.
C_3—10 μμfd. mica cond.
C_4—50 μμfd. mica cond.
C_5—20 μfd., 450 v. elec. cond.
C_6—.01 μfd., 600 v. cond.
C_7—.02 μfd., 600 v. cond.
C_8, C_{10}, C_{11}—40 μfd., 450 v. elec. cond.
C_9—.05 μfd., 600 v. cond.
C_{12}—200 μμfd. mica cond.
C—5 μfd., 400 v. cond.
T—Power trans. 360-0-360 v. @ 150 ma.; 5 v. @ 2 amps.; 6.3 v. @ 1 amp.; 6.3 v. @ 5 amps.
S_1—D.p.d.t. wafer sw.
S_2—S.p.s.t. toggle sw.
CH—8 hy. @ 150 ma. filter choke (Thordarson T-20C54)
L_1—1 mhy. r.f. choke (See text)
V_1, V_2—6SN7 tube
V_3—6AG7 tube
V_4, V_5, V_6—6Y6 tube
V_7—5Y3G tube

ing the war, but their operations were, of necessity, cloaked in secrecy. Suffice it to say that they comprise a sweep generator using high vacuum tubes instead of gas tubes.

These tubes, usually in the form of a multivibrator, are biased just as V_2 is in this pulse generator, so that it goes off only when a pulse is received. This multivibrator is coupled to a circuit which generates a linear saw-tooth whose length is very short, the exact length being determined by the phenomenon being observed.

For rough checking of several cycles, an ordinary scope may be used. Due to the limited sweep frequency, it will not be possible to observe a single cycle, but a check of the operation may be made.

Fig. 4 shows the picture that should be obtained when several cycles of the unit's output are under observation. The pulses will appear very dim at low recurrence rates and will by no means be brilliant at the highest rate.

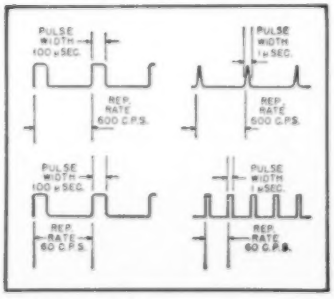
The main uses for this generator are: first, as a keying source for electronic circuits which operate only in the presence of a recurrent pulse; second, when one wishes to measure the operation time of a circuit or the duration of a waveform from a circuit. The pulse generator puts out a pulse which can be varied from one microsecond to 140 microseconds in width. Its rise time is better than .2 microsecond and the fall is better than .5 microsecond. The repetition rate may be varied from 60 to 600 cycles per second. The amplitude of the positive square wave is approximately 200 volts, and the negative wave is —125 volts. This negative amplitude is reached at less than the maximum position of R_{20}, but since the inverter tube will not handle a greater swing, this is as high as it should be turned.

If care is taken to use parts of exactly the value specified and if the layout is not changed appreciably, the calibration may be copied from the photograph. If more accurate calibration is desired the widths may be compared with sine waves of known frequency on an oscilloscope.

If the reader would like additional material on trigger circuits the author recommends a study of O. S. Puckle's book "Time Bases" (*Wiley*).

—30—

Fig. 4. Oscilloscope patterns obtained.



Mac's RADIO SERVICE SHOP

By JOHN T. FRYE

MENDING HARNESS

"THERE!" Mac said as he placed a little white radio on the "repaired" shelf; "that's the very last set we had to fix. We are all caught up."

"Hey!" his assistant, Barney, said in wide-eyed amazement, "what goes here? That's the first time I ever remember *that* happening. Is business falling off? Have you got my Social Security paid up?"

"Now don't get excited," Mac said soothingly. "Business is all okay. I have simply been putting in a lot of overtime lately. My wife has been visiting her sister in St. Louis this past week, and I got the fidgets sitting around home by myself; so I have been coming down here every night and knocking out several sets. You better turn in your Boy Scout badge for not having been observant enough to notice this."

"Well," Barney said complacently as he tilted the stool upon which he was sitting back against the wall and propped his generous-sized feet up on the service bench, "it is a revolting development, but we may as well face it. Just wake me up if any business comes in that requires my personal attention."

"Oh no you don't!" Mac said as he scooped a handful of shredded paper out of a tube-shipping box and sprinkled it over Barney's recumbent form. "We are going to do what we used to do when I was a boy down on the farm and a rainy day kept us out of the fields; namely and to wit: mend harness."

"Mend harness?" Barney questioned. "I always knew you worked me like a horse, but I never caught sight of any harness around here."

"A figure of speech, my boy," Mac explained. "I mean that we are going to take advantage of this lull to overhaul some of our equipment and otherwise catch up on some of the little things around the shop that we do not have time to take care of when business is rushing."

"That's got a kind of nasty sound to it," Barney commented dubiously. "What are some of those 'little things'?"

"First, I want every instrument in the shop thoroughly cleaned and waxed. I especially want those instruments that we take with us to the customer's home to be gleaming. A dirty instrument with frayed cord and test leads makes an impression on a customer about like that he would have if his doctor used a rusty stethoscope or a soiled tongue-depressor on him; but you will note that a doctor, that wisest of 'servicemen,' always sees to it that his instruments are immaculate.

"Replace any a.c. cords that show the least sign of insulation failure, and make up new test leads for all of the portable instruments. While you are at it, too, you may as well make up a few new test lead terminations."

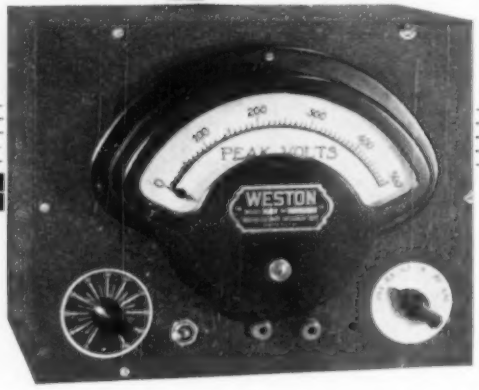
"What's a 'termination'?" Barney demanded.

"A big word to describe a useful little gadget. In ninety per-cent of the cases, the ordinary test prod is all you need; but there are times when it is handy or even necessary to have a needle-point prod or one with a clip on the end of the lead. It is foolish to lug around a pair of separate leads for each of these rarely-needed cases. If an alligator clip or a phono-needle

(*Continued on page* 102)

An OSCILLOSCOPE CALIBRATOR

By
DEAN KIMBALL



Over-all view of the oscilloscope calibrator. Any size cabinet which will house the meter can be used.

A variable source of a.c. voltage which is used to measure, by comparison method, any voltage from .015 to 500 volts.

UNTIL the advent of television, the oscilloscope was not widely used by the average service technician. Its use is almost a necessity in television service, however, and

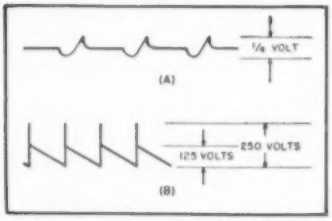
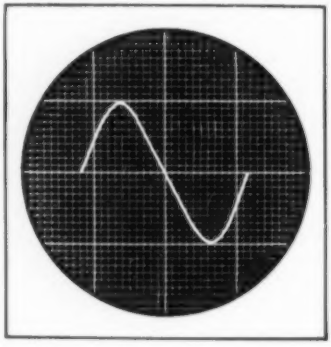


Fig. 1. Range of calibrated patterns encountered in most of the service manuals.

its introduction as a television service instrument will no doubt lead to its use for many other service problems for which it is peculiarly fitted. The oscilloscope is potentially a voltmeter with unique properties, because it is not only capable of measuring a wide range of voltages (.015 to 500 volts with a good oscilloscope) with almost any waveform, but it makes possible the visual analysis of the waveform and the frequency of the measured voltage. However, few oscilloscopes have any convenient means provided within them for measuring the actual value of the voltage applied to the input. The most that is done in oscilloscopes within the service instrument price range is to provide an internal signal of 6 volts or so for calibrating purposes. Obviously this is inadequate when the service manual probably will show calibrated patterns which range all the way from that of Fig. 1A to the pattern shown in Fig. 1B. When the oscilloscope is supplemented by the calibrator described herein, all such voltage measurements can be made conveniently.

The instrument described here is not a voltmeter in the usual sense of the word. Rather it is a variable source of a.c. voltage whose peak value is continuously measured by the built-in diode voltmeter. By means of the variable control, R_5, the voltage across the decade voltage divider can be set at any value between 50 and 500 volts. The voltage selected is applied to the input of the oscilloscope as a standard signal to set the gain of the oscilloscope at some convenient value, or the output of the calibrator may be matched with an unknown voltage to measure it. If a single-pole, double-throw switch (low capacity type) is placed at the input terminals of the oscilloscope, this calibrator then becomes a quickly available comparison standard for measuring voltages of all values within its range.

Fig. 2. Oscilloscope is adjusted so that signal under test fills a convenient number of squares. Calibrator is then switched in to measure the voltage of test signal.



The accuracy of the unit is affected by the following components; the quality of the meter, and the accuracy of the decade resistors. The series diode voltmeter is linear when used with load resistors above about 100,000 ohms. The condenser C_1 should be large enough to maintain the accuracy of the diode voltmeter at 60 cycles. If extreme precision in all parts of the meter scale is wanted, it would be wise to check the meter against a laboratory standard at several points on the scale, since meters which are not hand calibrated sometimes show rather large discrepancies at the low end of the scale. However, this is not necessary for most service work. Using the voltage ranges shown, the meter need have only one scale calibration of 0-500.

Circuit Details

Transformer T_1 is a small power transformer which will deliver slightly more than 500 volts peak. The center tap is not used. There need not even be any filament winding on T_1. A separate filament transformer is used for the 6H6, since filament voltage would not be constant if the filament winding were on the core of T_1.

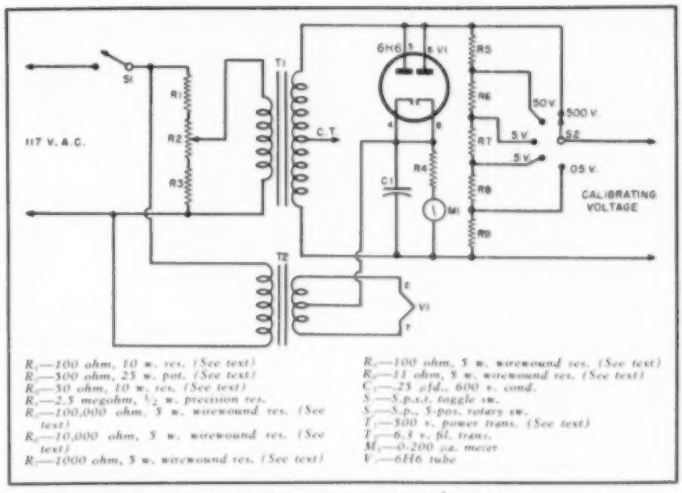
The voltage divider can be made up of stock wirewound, 5 or 10 watt resistors since these are cheap and quite accurate. However, if high accuracy is wanted, precision resistors could be used or the wirewound resistors could be selected for accuracy. Note that

the 100,000 ohm resistor should have a minimum rating of 2.5 watts.

Neither output terminal is grounded, therefore no polarity need be observed. However, when the selector is set on the 500 volt range, precautions should be taken to avoid shock and to avoid shorting the output terminals.

R_1 and R_2 should be adjusted so that R_3 covers the voltage range from about 40 volts to slightly over 500 volts. The values given are approximate and will vary with the rating of transformer T_2. These resistors also limit the current through R_3 so that it is not required to dissipate more than its rating.

The calibrator is built in a black crackle box. A box of this size is not necessary to house all the parts, but is needed to mount the large fan type meter used. If the constructor wishes to use a smaller meter, the parts could be mounted in a somewhat smaller box, thus making a more compact instrument. It is important to mount the potentiometer R_2 where it will have adequate ventilation since it dissipates about 20 watts. If it is mounted below the chassis, there should be a few ventilating holes drilled above it in the chassis. It would also be wise to drill a few holes in the side or bottom of the case to let in air. The back of the box is left open for ventilation. The placement of parts otherwise is not critical.



R_1—100 ohm, 10 w. res. (See text)
R_2—500 ohm, 25 w. pot. (See text)
R_3—50 ohm, 10 w. res. (See text)
R_4—2.5 megohm, ½ w. precision res.
R_5—100,000 ohm, 5 w. wirewound res. (See text)
R_6—10,000 ohm, 5 w. wirewound res. (See text)
R_7—1000 ohm, 5 w. wirewound res. (See text)
R_8—100 ohm, 5 w. wirewound res. (See text)
R_9—11 ohm, 5 w. wirewound res. (See text)
C_1—.25 μfd., 600 v. cond.
S—S.p.s.t. toggle sw.
S_2—S.p., 5-pos. rotary sw.
T_1—500 v. power trans. (See text)
T_2—6.3 v. fil. trans.
M_1—0-200 μa. meter
V—6H6 tube

Fig. 3. Diagram of calibrator. Unit may, alternatively, be built into scope cabinet.

Uses of the Calibrator

The major use of the calibrator will be for measuring the values of various parts of the waveforms encountered in checking a television receiver. This is done as follows: The gain control of the oscilloscope is set so that the pattern occupies some convenient number of squares on the crosshatched screen. See Fig. 2. The s.p.d.t. switch is then flipped over to the calibrator. Without moving the oscilloscope gain control, the controls R_2 and the decade switch are set so that the height of the pattern from the calibrator is the same as that to be measured. The value read on the meter multiplied by the value indicated by the decade switch then gives the peak value of the unknown voltage. Thus the voltages from the minimum indication of the oscilloscope up to 500 volts can be measured. By means of a voltage divider applied to the scope input, even higher voltages could be measured.

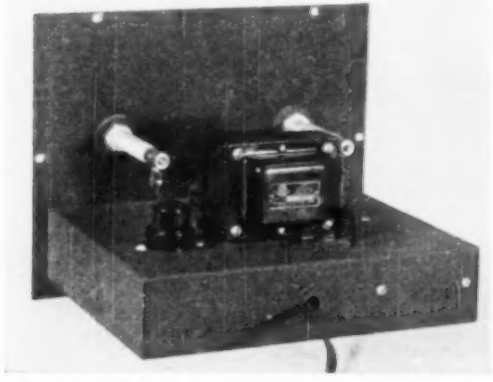
If the calibrator is constructed with good accuracy in mind, it becomes a standard by which other a.c. meters can be calibrated, and its use for a standard need not be limited to 60 cycle instruments. Meters can be calibrated at any frequency which is within the flat response range of the oscilloscope. It must be remembered that this unit measures peak and not r.m.s voltage.

The calibrator can be used to measure very low resistors with considerable accuracy. The unknown resistance can be set up in series with a known low resistor of similar value. By running a fairly large a.c. current through the combination the voltage drop across each resistor can be measured by means of the calibrator and the resistance of the unknown computed from these two readings. Lacking a known low resistor, an a.c. ammeter can be used to measure the current through the unknown. The voltage measuring leads should be attached to the unknown resistance inside where the current connections are clipped on so that the contact resistance of the current connections is not included in the measurement.

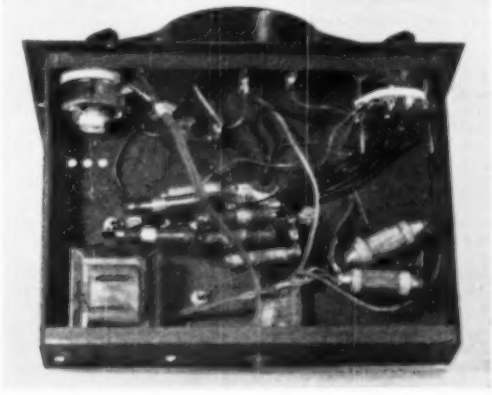
A few of many other uses are: measuring the voltage output of microphones, phonograph pickups, and other low voltage devices; checking amplifier input voltages, stage gain, and power output; and measuring the voltage of odd waveforms. Since the waveform is being observed on the oscilloscope, one can check the peak value or any other part of the wave.

—30—

Top chassis view of the home-built oscilloscope calibrator.



The under chassis view. Note the simplicity of the wiring.

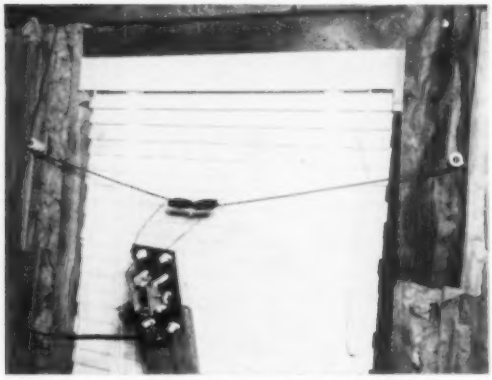


SIX BANDS - BUT NEAT

By
STAN JOHNSON, W0LBV

Details on two new, efficient amateur antennas which are inconspicuous and neat, yet cover all popular ham bands.

The end-fire array. This unit is made up of two standard roof-type whip antennas and a polystyrene rod.



"Attic view" of the end-fire array. The ends of the antennas are fed to a tuned circuit link-coupled to a 300 ohm line which goes to pick-up coil on the transmitter.

LIKE many another luckless ham, the writer lives in a new house —in a new and treeless district —where any ordinary beam would stick out like a sore thumb, and make for anything but good relations with the neighbors. Yet, like most hams, he hates to operate without a beam for 10 meters, and worse, he likes to work all bands, right up through 160 meters.

This article deals with a practical solution to the tough problem of providing an antenna system which will furnish a choice of two beams on 10 meters, plus an effective radiator on 15, 20, 40, 80, and 160 meters without creating a neighborhood eyesore. Proof that the antenna system is neat lies in a recent incident in which a ham from a neighboring state, trying to find the house by spotting the antenna system, wandered around the neighborhood for an hour and finally had to be "talked in" via the land line!

Essentially, the antenna system consists of two antennas; a two-element end-fire array fed at the bottom, and a long wire, end-fed with tuned feeders. The end-fire array is unique in that the only parts protruding from the house are two neat broadcast band-type "whip" antennas. The long wire, thanks to a careful choice of both feeder and flat top length, is readily tunable over a very wide frequency range with a simple tuner made up entirely from one of the inexpensive "TU" surplus tuning units from the BC-375 transmitter.

First, the end-fire array. This antenna is made up of two standard roof-type whip antennas which have the small whip ends folded down and joined by a light polystyrene rod. This method of construction insures that the spacing will remain uniform even in a fairly high wind, an important feature for a close-spaced array.

The additional length needed for each element of the 10 meter beam, plus the feed system, can be tucked away in almost any attic. The antenna is "pieced out" with lengths of RG-8/U cable (braid removed). Even better would be the use of heavy aluminum clothesline wire which would increase the frequency range of the antenna.

The ends of the antenna are brought together at a pair of insulators in series, as shown in the drawings and photograph.

There are several possible methods of feeding the antenna, and the two systems which the writer has tried are shown in the drawings. The simplest method, illustrated in one of the photos, is to use a tuned circuit link-coupled to a 300 ohm line of twin-lead which goes to the pick-up coil on the transmitter. The tuned circuit, which should have as large a coil and as little capacity as will still allow "loading up," is simply tuned to resonance as indicated by the old, familiar pick-up loop with its usual flashlight bulb.

An alternate system, which seems to be both less frequency-sensitive and more efficient, uses a quarter-wave matching stub. For detailed information on tuning up a stub see any of the standard handbooks. Suffice it to say that the antenna is first shock-excited by a nearby antenna, for example, by a folded dipole cut for 10 meters and connected to the 300 ohm feed line and then simply draped near the base of the antenna. The antenna is tuned to resonance as indicated by maximum brilliance in a flashlight bulb connected in the center of the shorting bar. Then the 300 ohm line is tapped on the stub at the point of lowest standing waves, as indicated by a standard twin-lamp standing wave indicator.

As the current at the connection to the antenna may be quite high, low power should be used on the exciting antenna to prevent burning out of the flashlight bulb.

The antenna is vertically polarized, of course. Contrary to a surprisingly common misconception, the transmitted polarization matters little for any

"skip" contact, as when the waves bounce off the ionosphere they wind up both vertically and horizontally polarized, willy-nilly. For ground wave contact, of course, polarization is important, and the beam works especially well with mobile rigs with vertical whips. Like any vertical antenna the two element beam is susceptible to man-made noise and is somewhat worse than a horizontal for BCI. But it is less apt to cause TVI—so name your poison.

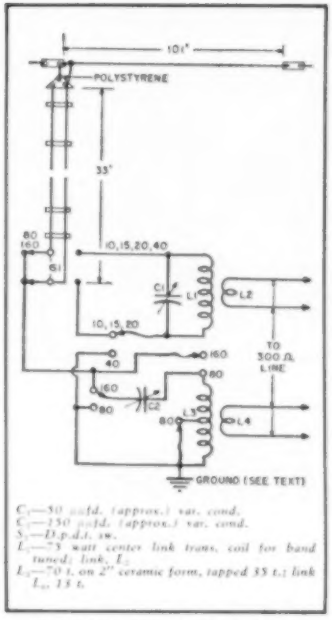
The vertical beam was placed in operation just as the 10 meter band was slipping into the summer slump, so results with the beam are not conclusive as this is written. But there is every indication that it will hold its own with any conventional two-element beam. There is considerable evidence that it really shines when the band is "sour." For example, it yielded an S8 from a KH6 in Hawaii when the KH6 was an S2—although running five times the power used in the writer's rig.

Now the "long" wire. Let no one sniff at a long wire for 10 meters. In theory, a wire three wavelengths long concentrates most of its radiation in the general direction of the wire, and at low angles, with a gain of about 2 db. The theory works out in practice and then some. The long wire shown in the drawings has been in use nearly a year. Although only 22 feet above the ground it yields consistent S9 plus reports from Hawaii with a 120 watt rig, has turned in S8's from Guam and Germany, and a 10 db. over S9 in Argentina. The four major lobes are vaguely apparent but the antenna does fairly well completely around the compass.

Besides being duck soup to erect, a long wire is a natural for tucking away inconspicuously. The writer's runs along the ridge of the house, just below the top of the roof, for the length of the house, then drops down at a slight angle to a pole at the edge of the alley. Since the pole was placed there by a large firm for another purpose nothing had to be erected to support the antenna. This mild chicanery is helped along by the fact that the antenna wire is #18 copperclad steel wire which is a bit hard to see even from 22 feet.

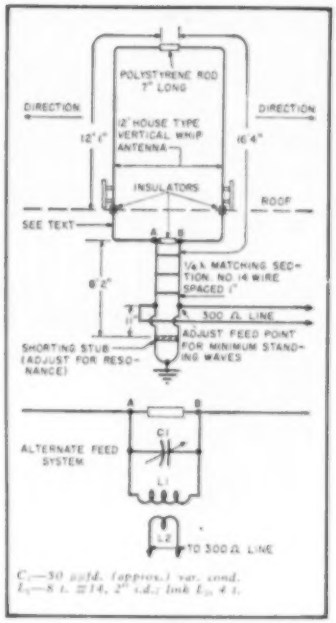
The 101 foot length chosen for the antenna represents about all that can be squeezed onto most city lots. Further, it is a nice length for a resonant flat top on 10, 15 (if we ever get it), and 20 meters. For 40 meters and 80 meters, the 33 foot open wire feeders (made with soft copper #18 wire and using 2 inch plastic spreaders approximately the same color as the roof) get into the act as part of the radiator, the net result being a 134 foot end-fed wire on 40 and 80 meters. On 160 meters, a ground is added, and the antenna worked as a Marconi.

The "ground" should be a good one. By the simple expedient of driving a 6 foot pipe down in one of the window wells alongside the house, dumping



C_1—50 $\mu\mu$fd. (approx.) var. cond.
C_2—150 $\mu\mu$fd. (approx.) var. cond.
S_1—D.p.d.t. sw.
L_1—75 watt center link trans. coil for band tuned; link, L_2
L_3—70 t. on 2" ceramic form, tapped 35 t.; link L_4, 15 t.

Details for constructing the six-band, long-wire antenna described in text.



C_1—50 $\mu\mu$fd. (approx.) var. cond.
L_1—8 t. #14, 2" i.d.; link L_2, 4 t.

Diagram of the end fire array which uses two whip antennas and the rod.

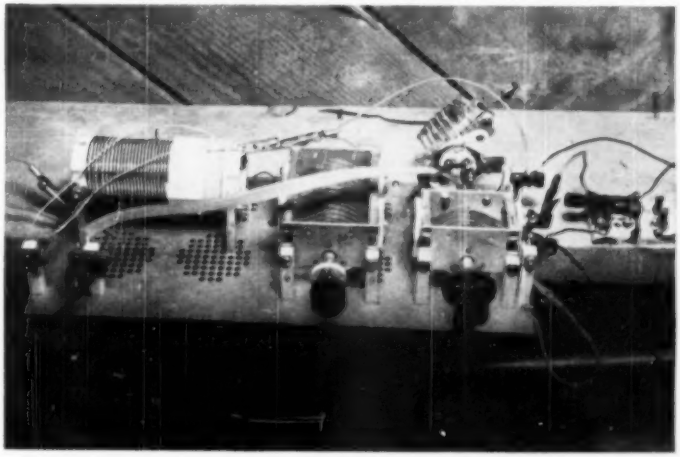
in 20 pounds of salt, and soaking the works for a couple of days, the output from the writer's 160 meter rig climbed 6 db. at a test point in another state. Since 6 db. is equivalent to quadrupling the power the 40¢ worth of salt was the best buy in town.

The tuner for the long wire antenna uses two variable condensers from the "TU" tuning unit mentioned previously, two coils, one wound up on a form salvaged from the tuning unit and one a standard 75 watt coil, and miscellaneous clips and insulators. The diagram shows how tuning can be provided on ary of the bands simply by shifting the clips to get the proper combination.

How should the antennas be oriented? Well, that will depend upon a lot of variables, including the real estate and the countries you want to work. In any case, the ideal scheme is to mount the antennas at right angles to each other. If this is done, you can work in almost any direction; both antennas are bi-directional on 10 meters.

—30—

Tuner for the long-wire antenna. Complete wiring details are shown in schematic above.



PICTURE DISTORTION

Due to Horizontal Foldover

A review of the causes of an annoying interference problem that has baffled many service technicians.

By
D. LERNER & J. HOWELL
Philco Corporation

ONE type of picture distortion which appears puzzling to many service technicians is the effect of "horizontal foldover." This distortion might take place in a scene where a person in the field of action walks to the left of the screen, seemingly out of camera range, only to appear to reverse his direction and stroll back again to the right, while enveloped in a filmy light background.

This peculiar effect is caused in most cases by the unblanking of the picture tube before the electron beam, during its retrace time, has completely finished its journey across the screen from right to left. Since the speed of the electron beam across the picture tube face during retrace is about five times as fast as its speed during the scanning period, much less energy is imparted to the fluorescent screen by the retracing electron beam. Thus the short strip or area on the left-hand side of the screen, during the time while the retrace is visible, appears much less bright than that portion of the picture scanned during the normal trace period. Because the direction of the electron beam reverses completely from retrace to trace period, the scene is scanned in opposite directions and the area of double scanning on the left portion of the screen is folded over on itself. Hence the name, "horizontal foldover."

Referring to Fig. 1, the relation in time between the horizontal blanking pedestal and the horizontal saw-tooth sweep signal is shown. In many receivers the horizontal oscillator is triggered by the leading edge of the horizontal sync pulse. Therefore, the time that remains for complete horizontal retrace is that time between the leading edge of the sync pulse and the end of the "back porch" (see Fig. 1). The time allotted for retrace may be decreased too much if the back porch, as transmitted by the station, is too short.

Fig. 1. Sync pulse saw-tooth relationship.

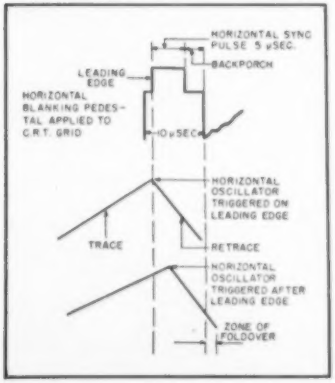
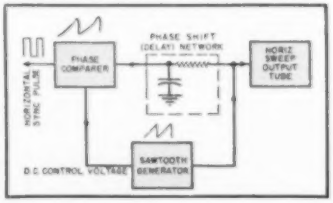


Fig. 2. Diagram of the a.f.c. pulse width horizontal sync circuit with delay network.



The return time from right to left may be lengthened, in some cases, due to variations in inductance of the horizontal deflection yoke.

In receivers using the a.f.c. (automatic frequency control) pulse width system of horizontal sweep, the oscillator does not sync in (trigger) on the leading edge of the sync pulse, but rather some time (a few microseconds) afterwards. See Fig. 1. Thus the foldover condition is exaggerated by the over-all reduction in time allotted for spot return.

To overcome the effect of foldover at the transmitter, the sync pulse may be speeded up so that it effectively moves over to the left on the pedestal and thus lengthens the back porch. At the receiver the entire horizontal sweep may be speeded up in relation to the blanking pulse applied to the picture tube, and this can be accomplished rather easily in receivers using the a.f.c. pulse width type of sync.

Briefly, the operation of the a.f.c. pulse width type of sweep circuit is as follows: The incoming horizontal sync pulse is combined with a portion of the horizontal saw-tooth voltage that is used for horizontal deflection in the phase comparer circuit. The resultant d.c. voltage, developed across the phase comparer cathode load, is used to control the frequency of the horizontal oscillator. This is shown in simple block form in Fig. 2. If we could make the saw-tooth used for deflection purposes lead the saw-tooth used for phase comparison, we would, in effect, have accomplished the same purpose as speeding up the sweep with respect to the blanking pulse. This is done by a simple delay network consisting of a resistor and condenser, as shown in Fig. 3.

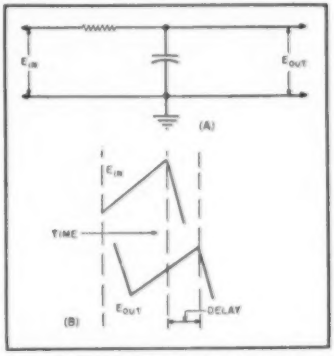


Fig. 3. Diagram of a simple delay network.

The output voltage E_{out} will lag the input E_{in} because of the finite time required to charge the condenser through the series resistance. Looking at the circuit another way, we can say that the input voltage E_{in} leads the output voltage E_{out}. By inserting a delay or phase shifting circuit in series with the saw-tooth feeding the phase comparer,

(*Continued on page* 139)

12 Improvements IN NEW 1951

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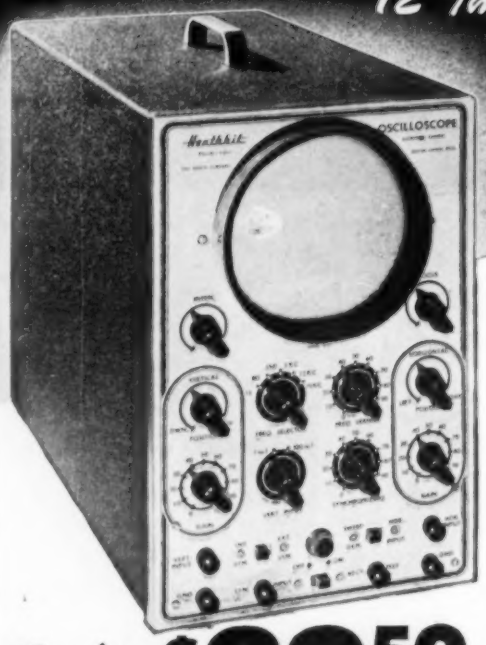

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- ★ Improved amplifiers for better response useful to 2 megacycles.
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- ★ Improved Allegheny Ludlum magnetic metal CR tube shield.
- ★ New synchronization circuit works with either positive or negative peaks of signal.
- ★ New extended range sweep circuit 15 cycles to over 100,000 cycles.
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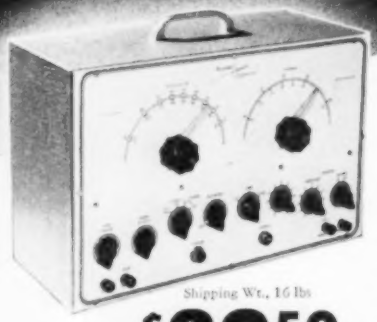

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The variable master oscillator covers 150 to 230 Mc. thus giving high output fundamentals where they are most needed. Low band coverage 2 Mc. to 90 Mc.

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- Beautiful 3 color meter — reads good-bad and line set point.

Test your tubes the modern way — dynamically — the simplest, yet fastest and surest method — your Heathkit has a switch for each tube element and measures that element — no chance for open or shorted elements slipping by, all the advantages of the mutual conductance type without the slow cumbersome time consuming setups.

Your Heathkit Tube Checker has all the features — beautiful 3 color BAD-GOOD meter — complete selection of voltages — roller chart listing hundreds of tubes including the new 9 pin miniatures — finest quality Centralab lever switches for each element — high grade birch counter type cabinet — continuously variable line adjust control — every feature you need to sell tubes properly. The most modern type tube checker with complete protection against obsolescence. The best of parts — rugged oversize 110 V. 60 cycle power transformer — finest of Mallory and Centralab switches and controls, complete set of sockets for all type tubes with blank spare for future types. Fast action brass gear driven roller chart quickly locates the settings for any type tube. Simplified switching cuts necessary testing time to minimum and saves valuable service time. Short and open element check. Simple method allows instant setup of new tube types without waiting for factory data. No matter what the arrangements of tube elements, the Heathkit flexible switching arrangement easily handles it. Order your Heathkit Tube Checker Kit today. See for yourself that Heath again saves you two-thirds and yet retains all the quality — this tube checker will pay for itself in a few weeks — better assemble it now. Complete with instructions — pictorial diagrams — all parts — cabinet — ready to wire up and operate. Model TC-1 Shipping Wt., 12 lbs.

$29.50

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NEW 1951

Heathkit SIGNAL GENERATOR KIT

Features

- Sine wave audio modulation.
- Extended range 160 Kc. to 50 megacycles fundamentals.
- New step attenuator output.
- New miniature HF tubes.
- Transformer operated for safety.
- Calibrated harmonics to 150 megacycles.
- New external modulation switch.
- 5 to 1 vernier tuning for accurate settings.

A completely new Heathkit Signal Generator Kit. Dozens of improvements. The range on fundamentals has been extended to over 50 megacycles; makes this Heathkit ideal as a marker oscillator for T.V. New step attenuator gives controlled outputs from very low values to high output. A continuously variable control is used with each step. New miniature HF tubes are required for the high frequencies covered.

Uses 6C4 master oscillator and 6C4 sine wave audio oscillator. The set is transformer operated and a husky selenium rectifier is used in the power supply. The coils are precision wound and checked for calibration making only one adjustment necessary for all bands.

New sine wave audio oscillator provides internal modulation and is also available for external audio testing. Switch provided allows the oscillator to be modulated by an external audio oscillator for fidelity testing of receivers.

A best buy — think of all the features for less than $20.00. The entire coil and tuning assembly are assembled on a separate turret for quick assembly — comes complete — all tubes — cabinet — test leads — every part. The instruction manual has step-by-step instructions and pictorials. It's easy and fun to build a Heathkit Model SG-6 Signal Generator. Shipping Wt., 7 lbs.

$19.50

Heathkit SINE AND SQUARE WAVE AUDIO GENERATOR KIT

Either sine or square wave.
Stable RC bridge circuit.
Covers 20 to 20,000 cycles.
Less than 1% distortion.

Hundreds of Heathkit Audio Generators are used by speaker manufacturers—definite proof of their quality and dependability. The added feature of square wave opens up an entirely new field of amplifier testing. Uses the best of parts, 4 gang condenser, 1% calibrating resistors, metal cased filter condensers, 5 tubes, completely calibrated panel and detailed instruction manual. One of our best and most useful kits. Model G-2. Shipping Wt., 12 lbs.

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THE NEW Heathkit HANDITESTER KIT

- Beautiful streamline Bakelite case.
- AC and DC ranges to 5,000 Volts.
- 1% Precision ceramic resistors.
- Convenient thumb type adjust control.
- 400 Microampere meter movement.
- Quality Bradley AC rectifier.
- Multiplying type ohms ranges.
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- Large quality 3" built-in meter.

A precision portable volt-ohm-milliammeter. An ideal instrument for students, radio service, experimenters, hobbyists, electricians, mechanics, etc. Rugged 400 ua meter movement. Twelve complete ranges, precision dividers for accuracy. Easily assembled from complete instructions and pictorial diagrams. An hour of assembly saves one-half the cost. Order today. Model M-1. Shipping Wt., 2 lbs.

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Features

- Provides variable DC voltage for all checks.
- Locates sticky vibrators-intermittents.
- Voltmeter for accurate check.
- Has 4000 MFD Mallory filter for ripple-free voltage.

Even the smallest shop can afford the Heathkit Battery Eliminator Kit. A few auto radio repair jobs will pay for it. It's fast for service, the voltage can be lowered to find sticky vibrators or raised to ferret out intermittents. Provides variable DC voltage 5 to 7½ Volts at 10 Amperes continuous or 15 Amperes intermittent. Also serves as storage battery charger. Ideal for all auto radio testing and demonstrating.

A well filtered rugged power supply uses heavy duty selenium rectifier, choke input filter with 4,000 MFD of electrolytic filter for clean DC. 0-15 V. voltmeter indicates output which is variable in eight steps. Easily constructed in a few hours from our instructions and diagrams — better be equipped for all types of service — it means more income. Model BE-2. Shipping Wt., 19 lbs.

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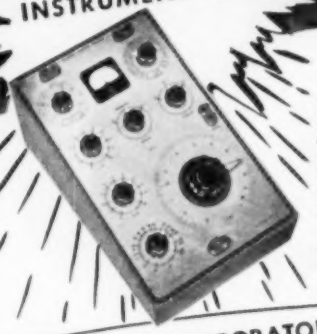
New LABORATORY INSTRUMENT KITS



HUNDREDS OF LABORATORIES USE

Heathkit IMPEDANCE BRIDGE as Standard

Features

- Measures inductance 10 microhenries to 100 henries
- Measures resistance .01 ohms to 10 megohms
- Measures capacitance .00001 MFD to 100 MFD
- Measures "Q" and power factor.

Measures inductance from 10 microhenries to 100 henries, capacitance from .00001 MFD to 100 MFD. Resistance from .01 ohms to 10 megohms. Dissipation factor from .001 to 1. "Q" from 1 to 1,000. Ideal for schools, laboratories, service shops, serious experimenters. An impedance bridge for everyone — the most useful instrument of all, which heretofore has been out of the price range of serious experimenters and service shops. Now at the lowest price possible. All highest quality parts. General Radio main calibrated control. General Radio 1,000 cycle hummer. Mallory ceramic switches with 60 degree indexing — 200 microamp type binding posts with standard ¾" centers. Beautiful birch cabinet. Directly calibrated "Q" and dissipation factor scales. Ready calibrated capacity and inductance standards of Silver Mica, accurate to ½ of 1% and with dissipation factors of less than 30 parts in one million. Provisions on panel for external generator and detector. Measure all your unknowns the way laboratories do — with a bridge for accuracy and speed.

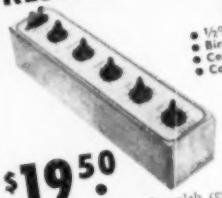
$69.50

Internal 6 Volt battery for resistance and hummer operations. Circuit utilizes Wheatstone, Hay and Maxwell circuits for different measurements. Supplied complete with every quality part — all calibrations completed and instruction manual for assembly and use. Deliveries are limited. Model IB-1. Shipping Wt., 15 lbs.

NEW Heathkit LABORATORY

RESISTANCE DECADE KIT

Features



- ½% Accuracy
- Birch Cabinet
- Ceramic Switches
- Covers 1 ohm to 99,999 ohms

$19.50

The new Heathkit Resistance Decade is a handy tool for laboratory, school and service shop. Ideal for test setups, calibrating instruments, bridge measurements, selecting multipliers, etc.

Uses the finest Centralab ceramic switches, 1% ceramic decade resistors and heavy birch cabinet matching other laboratory equipment. The range is 1 ohm to 99,999 ohms in one ohm steps.

Finest quality throughout to withstand school usage — heavy aluminum panel — laboratory type binding posts — the fine decades are extremely simple to assemble — complete kit. Model RD-1. Shipping Wt., 4 lbs.

NEW Heathkit LABORATORY

POWER SUPPLY KIT

Features

- Supplies 6.3 V. AC at 4.5 Amps.
- Heavy duty construction.
- Handy for schools, labs., and service shops.
- Supplies variable DC 50-300 Volts.
- Shows voltage or current on 3½" meter.

This new Heathkit Variable Power Supply Kit fills hundreds of needs — use it for experimental circuits — no need to build a separate power supply — use it for a test voltage to determine proper coefficients in unknown circuits — calibrate instruments with its variable voltage, etc. This new Heathkit supplies 50 to 300 Volts continuously variable DC together with an AC filament voltage of 6.3 Volts at 4.5 Amperes. A built-in 1 MA 3½" meter has proper shunts to read 0-500 Volts and 0-200 Milliamperes. The circuit uses a 5Y3 rectifier, two 1619 tubes as electronic control tubes to vary the output voltage with a single potentiometer. Case measures 7⅛" x 13" x 7⅛". Has instruction manual for assembly and use. Model PS-1. Shipping Wt., 18 lbs.

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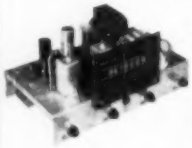
Heathkit RECEIVER & TUNER KITS for AM and FM

TWO HIGH QUALITY Heathkit SUPERHETERODYNE

RECEIVER KITS



Model BR-1 Broadcast Model Kit covers 550 to 1600 Kc. Shipping Wt., 10 pounds.

$19.50

Model AR-1 3 Band Receiver Kit covers 550 Kc. to over 20 Mc. continuous. Extremely high sensitivity. Shipping Wt., 10 lbs.

$23.50

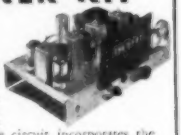
Two new Heathkits. Ideal for schools, replacement of worn out receivers, amateurs and custom installations.

Both are transformer operated quality units. The best of materials are used throughout — six inch calibrated slide rule dial — quality power and output transformers — dual iron core shielded I.F. coils — metal filter condensers and all other parts. The chassis has phono input jack — 110 Volt outlet for phono motor and there is a phono-radio switch on panel. A large metal panel simplifying installation in used console cabinets is included. Comes complete with tubes and instruction manual incorporating pictorials and step-by-step instructions (less speaker and cabinet). The three band model has simple coil turret which is assembled separately for ease of construction.

TRUE FM FROM Heathkit

FM TUNER KIT

$22.50



The Heathkit FM Tuner Model FM-2 was designed for best possible tonal reproduction. The circuit incorporates the most desirable FM features — true FM — ready wound and adjusted coils — 3 stages of 10.7 Mc. I.F. (including limiter).

Tube lineup: 7E5 oscillator, 6SH7 mixer, two 6SH7 I.F. stages, 6SH7 limiter, two 7C4 diodes as discriminator, 6X5 rectifier.

The instrument is transformer operated making it safe for connection to any type receiver or amplifier. The R.F. coils are ready wound — mounted on the tuning condenser and the condenser is adjusted — no R.F. coils to wind or adjust.

A calibrated six inch slide rule dial has vernier drive for easy tuning. The finest parts are provided with all tubes, punched and formed chassis, transformers, condensers and complete instruction manual. Model FM-2. Shipping Wt., 10 lbs.

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ENJOY MUSIC AT ITS *Finest* WITH *Heathkit* AMPLIFIERS

NEW *Heathkit* HIGH FIDELITY 20 WATT AMPLIFIER KIT

$21.50

Features

- Push-pull 6L6's.
- Full 20 Watts output.
- Fully enclosed chassis.
- Provisions for reluctance pickup compensation stage.
- Cased high fidelity output transformer.
- Treble and bass boost tone controls.
- Full range of output impedances 3.2 ohms to 500 ohms.

The finest amplifier kit we have ever offered — check the features. This inexpensive amplifier compares favorably with instruments costing five times as much. Nothing has been spared to provide the best reproduction — an ideal amplifier for the new Heathkit FM Tuner listed below.

Dual tone controls for control of both treble and bass. Bass control is of the boost type for maximum listening pleasure. Optional preamplifier stage for use with G. E. reluctance pickup or microphone. Uses inverse feedback to give excellent response over entire range. Tube lineup: 6SJ7 preamplifier stage, 6J5 phase splitter stage, two 6L6's in push-pull and 5Y3 rectifier. 6SC7 as optional compensation stage.

Uses highest quality Chicago Transformer Corporation cased output transformer with taps of 3.2, 8, 15, 60 and 500 ohms to match any speaker combination. Power transformer is conservatively rated for continuous operation in sound systems. Tone control gives maximum bass boost of 6 db at 70 cycles. Amplifier has maximum gain of 75 db. Response within 3 db 20 to 20,000 cycles. Shipping Wt., 17 lbs. Complete with all parts, tubes and instruction manual.

Model A-5A Amplifier with preamplifier for G. E. cartridges or microphone . . . $23.50
12" 20 Watt Speaker, No. 326 . . . 7.50

Heathkit ECONOMY 6 WATT PUSH-PULL AMPLIFIER KIT

$12.50

No. 304, 12-inch Speaker $6.95

This new Heathkit Amplifier was designed to give quality reproduction at a very low price. Has two preamp stages, phase inverter stage and push-pull beam power output. Comes complete with six tubes, quality output transformer (to 5-4 ohm voice coil), husky cased power transformer and all other parts. Has tone and volume controls. Instruction manual has pictorial for easy assembly. Six watt output with response flat +- 1½ db from 50 to 15,000 cycles. A quality amplifier kit at new low price. Better build one. Model A-4. Shipping Wt., 7 lbs.

Heathkit RECEIVERS and TUNER CABINETS

$4.95

Order No. 350 for FM tuner

Blonde birch veneer cabinet for either the receivers or tuner. Modern styling is an asset to any room. 5" speaker fits in end of cabinet when used with receivers. Size 7 x 15½ x 8¼ inches. Shipping Wt., 5 lbs.
Order No. 345 for either receiver

Metal professional type communications receiver cabinet. Finished in deep grey to fit the panel supplied with Heathkit BR-1 and AR-1 Receivers (panel shown not included with cabinet). 5" speaker mounts in end of cabinet. Gives professional appearance to Heathkit receivers. Size 7 x 14 x 7¼ inches. Shipping Wt., 6 lbs.

5" Permoflux Speaker for either cabinet for use with either Heathkit Receiver No. 320 5" Speaker . . . $2.75

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No. 335 Cabinet for receivers only

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	Heathkit T.V. Alignment Gen. Kit — TS-2	
	Heathkit FM Tuner Kit — FM-2	
	Heathkit Broadcast Receiver Kit — Model BR-1	
	Heathkit Three Band Receiver Kit — Model AR-1	
	Heathkit Amplifier Kit — Model A-4	
	Heathkit Amplifier Kit — Model A-5 (or A-5A)	
	Heathkit Tube Checker Kit — Model TC-1	
	Heathkit Audio Generator Kit — Model G-2	
	Heathkit Battery Eliminator Kit — Model BE-2	
	Heathkit Electronic Switch Kit — Model S-2	

Quantity	Item	Price
	Heathkit VTVM Kit — Model V-4A	
	Heathkit R.F. Probe Kit — No. 309	
	Heathkit H.V. Probe Kit — No. 336	
	Heathkit R.F. Signal Gen. Kit — Model SG-6	
	Heathkit Condenser Checker Kit — Model C-2	
	Heathkit Handitester Kit — Model M-1	
	Heathkit Variable Power Supply Kit — Model PS-1	
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An Inexpensive CONDENSER AGER

Rejuvenate those electrolytics. Don't take a chance on that old condenser and burn out a power supply.

By

JAMES W. LASSITER

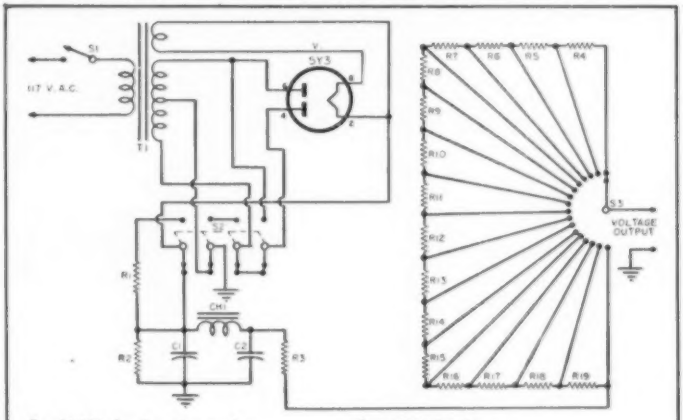
FROM time to time the experimenter can obtain electrolytic condensers at greatly reduced prices, and he often has a number scattered around which have not seen use for months. All electrolytic condensers show a decrease in leakage resistance after a period of idleness, and initially may leak as much as five milliamperes per microfarad of capacity when first placed in use, this leakage current dropping rapidly to normal amounts in from three to ten minutes, depending on rated voltage. The great disadvantage of this is the possibility of overloading the transformer and rectifier during this initial period, with consequent burnout.

This disadvantage is easily overcome by aging the condenser through the application of voltage prior to its use, just as was done during its manufacture. Commercial designs for aging devices call for heavy duty parts, all expensive. The design covered in this article will apply up to 600 volts d.c. to the condenser, and the resistance of the condenser at the applied voltage is easily determined.

The circuit is unusual in that the secondary of a center-tapped transformer is used with a full-wave rectifier for lower voltages, and by means of a switch, with a half-wave rectifier for higher voltages. The peak inverse voltage is kept within the rectifier rating, and current flow is sufficiently low to prevent core saturation in the transformer secondary. In lieu of a variable resistor in the transformer primary (for voltage control), which would require a separate filament transformer, a 17-position, single-pole switch is wired as a rheostat.

As the circuit resistance is known at any position of the switch, the resistance of the condenser is found by measuring total circuit voltage, the voltage across the condenser, and then solving by the proportion: Total circuit voltage minus condenser voltage is to

Circuit diagram. It will give you quality status of electrolytics up to 600 v. d.c.



R_1—50,000 ohm, 5 w. wirewound res.
R_2—1.5 megohm, 1 w. res.
R_3, R_{19}—5000 ohm, 10 w. wirewound res.
R_4—2.2 megohm, ½ w. res.
R_5—1 megohm, ½ w. res.
R_6—270,000 ohm, ½ w. res.
R—180,000 ohm, 1 w. res.
R_7—150,000 ohm, 1 w. res.
R_8—120,000 ohm, 1 w. res.
R_9—90,000 ohm, 2 w. res.
R_{10}—60,000 ohm, 2 w. res.
R_{11}—12,000 ohm, 1 w. res.
R_{12}—10,000 ohm, 1 w. res.
R_{13}—9000 ohm, 2 w. res.
R_{14}—8000 ohm, 5 w. wirewound res.
R_{15}—7000 ohm, 5 w. wirewound res.
R_{16}—6000 ohm, 5 w. wirewound res.
R_{17}—5000 ohm, 5 w. wirewound res.
C_1, C_2—4 μfd., 1000 v. cond. (See text)
CH—15 hy., 50 ma. choke (See text)
S—5-p.s.t. sw.
S—4-pos. d.t. sw.
S—17-pos. s.t. sw.
T—Power trans. 240-0-240 @ 40 ma.; 5 v. @ 2 amps.
V—5Y3GT or 80 tube

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known resistance as condenser voltage is to condenser resistance. Because of the high circuit resistance a vacuum tube voltmeter is advisable.

In practice, a fairly large resistance is introduced into the circuit and direct readings of the voltages developed are taken. As the condenser ages, the voltage across it rises, and this voltage is readily adjusted by varying the circuit resistance. Electrolytic condensers should have a resistance in excess of 500,000 ohms at the applied voltage. Time required to age the condenser will vary with shelf time, capacity, and voltage rating, all of these factors increasing the time. Seldom will more than a very few minutes be necessary. Values have been chosen to give a wide range of control.

The author combined the tester with a power supply for experimental purposes. For those not wanting this feature the condensers and choke may be omitted, and a simple *RC* filter for meter protection substituted if desired. The total cost, with condensers and a 5"x9"x3" chassis, was less than $10.

—30—

SOMETHING FOR NOTHING?

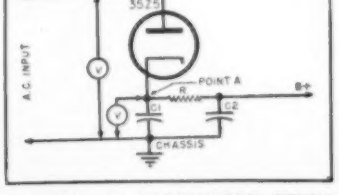
By ROBERT HERTZBERG

MOST radiomen get their first practical circuit experience by poking around the chassis of an ordinary five-tube a.c.-d.c. receiver. If you have a voltohmmeter, you can have a bit of fun. Set it for a.c. and touch its leads to the chassis and pin 5 of the 35Z5 (see Fig. 1); it will read the line voltage, say 120. Shift the meter to d.c. and touch the probes to ground and Point A in the diagram. The latter is representative of the transformerless power supplies in general use. You're expecting a lower voltage, because you know that the rectifier tube introduces a drop, but the meter reads about 135. "Are we getting something for nothing?" you ask.

No. Remember that an a.c. meter reads "effective" value, which is between the zero and the peak points of the a.c. alternation. The zero value is of course zero, but many experimenters overlook the fact that the peak is 1.4 times the "effective" meter reading. This brings the actual top voltage in this case to 168. There is a drop through the rectifier, but what is left is still more than 120 volts, and the filter condenser C_1 (of the dual C_1-C_2, 40-20 μfd. unit) charges at this higher voltage and a d.c. meter at this point indicates it.

—30—

Fig. 1



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- NEW HEAVY DUTY CONSTRUCTION

"WHY PAY MORE?" SALE PRICE **$12.95** Model CU-14X

McGee announces our new 1951 model 12-inch coaxial speaker, designed for the critical music listener, for use with high fidelity audio systems and radios. This is a model reproduces all music and voice with a natural quality. It is improved over our last model in that the 12" woofer now has a heavy duty 31 oz. Alnico 5 magnet. This reproduces the lower musical register down to 40 cycles. The cone is suspended by a specially designed cone for the higher register of music and voice. It will respond up to 17,500 CPS. The high pass filter is attached and contained inside the speaker. It will not require a separate unit to be used in front of the speaker. It will hook up to any 8 ohm output transformer. It will connect in place of any ordinary speaker only two wires to connect. Why pay $20 to $40 for a speaker? McGee has the speaker for you. Why pay $20 to $40 for the installation charge? McGee will do the installing and contained insulance will hook up to any 8 ohm output transformer. It will connect in place of any ordinary speaker only two wires to connect. Why pay $20 to $40 for a speaker? McGee has the speaker for you. Why pay $20 to $40 for the installation charge? McGee will do the installing and save you the money. We have sold over 10,000 coaxial speakers. Why pay more from McGee's price? Model CU-14X, 20 watt wide range coaxial FM speaker. Model CU-14X. Net price, only $12.95. Model CU-14X. Net price, only $25.00.

SUPER HEAVY DUTY 10" PM $4.95

We made a special purchase on several hundred 20 watt, 10", 32 oz. Alnico 3 magnet PM speakers. Deep throat and moving cone. Ideal for all high fidelity sound systems and radio replacement. The magnet on this speaker is usually used on a 15" size. Very efficient, good high and bass response. You'll appreciate it when you get your hands on this speaker. Voice coil impedance, 4 ohms. Stock No. 1025PS. Weight 7 lbs. Net price $4.95 each.

Order three of these and use them in a cluster of three. They will take 60 watts of audio and have more cone area than any 15" speaker, for high power, top quality P.A. work. Think this over! 3 No. 1025PS speakers for only $13.95.

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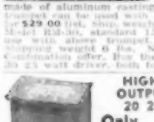
25 WATT DRIVER AND TRUMPET $23.95

This trumpet and driver is specially designed for all outdoor speaker uses; churches, sound trucks, etc. It is the most popular size sold today. McGee offers you more for your money. Each speaker is fully guaranteed. Model NX-100, all weather proof 31½ foot trumpet, complete with mounting bracket. Regular $29.00 list, ship. weight 15 lbs. Net price $13.50. Model RM-30, standard 16 ohm, 25 watt driver for use with above trumpet. Ship. weight 6 lbs. Net price $12.50. Combination offer. Buy the NX-100 trumpet and RM-30 25 watt driver, both for only $23.95.

10 WATT PAGING SPEAKER $11.95

Model 10-XXP, 10 watt paging speaker with built-in weather proof driver. Spun aluminum construction, 8 ohm voice coil. Regular net on this speaker is over $15.00. A special purchase by McGee makes this $11.95 price possible. Ship. weight 4 lbs.



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A-403—6000 ohms. Plate to Plate.

Why pay $20.00 or $30.00 for an output? Superior quality and high fidelity output transformer. Designed for push-pull 6V6 tubes (2-6L6, 2-6V6, or 2-6AQ5 class AB1 or AB2 operation. Primary impedance 6000 ohms. Frequency response 20 to 20,000 cycles. We have tried several high fidelity outputs in our lab and find this to be the best value. Power rating 25 watts. Although only rated at 10 or 15 watts, this 34 watt unit is what you should use. Complete with instructions are furnished Stock No. A-403. Net price ..... $6.95 shipping weight 8 lbs.

40-WATT OUTPUT "CAPEHART" HIGH FIDELITY $7.95

Stancor built for Capehart for this finest combination. Will work with all windings interwound to increase high frequency response and decrease eddy current losses. High inductance primaries for best efficiency at low audio frequencies. Push-pull high fidelity output transformer is fully shielded and has a net weight of 8 lbs. Made to match push-pull 6L6 tubes 5,000 ohms plate to plate. Secondary winding for 15½ feed back and 4 ohm voice coil. Stock No. A-4015. Net price ..... $7.95 shipping weight 8 lbs. Stock No. A-4016, for 20 cycles and above 20,000 cycles. Furnished with connecting instructions. Stock No. A-4016. Net price ..... $7.95 shipping weight 8 lbs. Stock No. SX-35, net ..... $7.95 Stock No. SX-50, net ..... $4.95 Stock No. SX-35 and SX-50 are identical except for weight. Same winding. Shipping weight 3 lbs., net $4.95

NEW 1951 MODEL 15" "COAXIAL" PM SPEAKER

20TH ANNIVERSARY SALE PRICE **$17.95** Model P15-0

McGee's new 1951 Model 15" coaxial PM speaker is the finest we have ever offered. And at a price everyone can afford. $17.95. This speaker is ideal for all types of radio and audio amplifier use. It is designed to be connected to any 8 ohm output transformer. The 15" woofer has a 32 oz. Alnico 5 magnet and the exceptionally suspended 5" speaker has its own magnet and voice coil. A true coaxially built speaker. The high pass filter prevents low frequency notes from reaching the tweeter. The response of this 15" coaxial is from 30 CPS to 17,500 CPS. If you have or are building one of our high fidelity amplifier kits, this speaker is the one you should have. It is a tremendous value. Why pay more than McGee's price, for a 15" coaxial speaker? Stock No. P15-0. Shipping weight 14 lbs. 20th Anniversary sale price, only $17.95. 2 for $34.00.

20TH ANNIVERSARY INTERCOM SALE!

$25,000 WORTH OF INTERCOMS AT SCOOP PRICES

5-STATION INTERCOM MASTER

MASTER STATION **$14.95** SUB STATION **$3.95** EACH

5 station intercom master station, in an attractive walnut cabinet, 10x12x4". 5 pushbuttons, you can call any one or more substations. Talk-listen switch has a silent position. Volume control on front panel for any station. The amplifier is of the conventional AC-DC design, with plenty of power. Equipped with a full size 8" Alnico 5 PM speaker. The intercom master is new 1950 production by a well known factory. Made to sell at a price to meet the lowest price on the market. If bought separately, the price would be $24.95 each. 5 station intercom master No. 2700. Weight 7 lbs. Net price $14.95.

Intercom master, same as above, except in addition to the 5 station switch a 6th pushbutton is added so that all stations at once. Stock No. 2701. Net price $16.95 each.

Molded walnut plastic substations for use with Model 2520 Master. Five inch Alnico 5 square PM speaker, spring return call-back switch, size 5½x8½x3½". Ship. weight 2 lbs. each. Mounts either on the wall or may be set on desk top. Any attractive finish. Price $3.95 each. 5 for $18.95. 3-wire matching intercom cable, 50 ft. $1.50, 100 ft. $2.50, 500 ft. $7.50, 1000 ft. $12.60.

10-STATION A.C. MASTER STATION $24.95

- Powerful—6V6 Output Tube
- Walnut Veneer Cabinet
- Push Button Selector
- Sub Stations $3.95 Each

Super heavy duty, 10 station intercom master, designed for multi-family use. Has the same transformer type with 80 rectifier, 6V6 output and 6SJ7 tube. Has 5" speaker with 3 watt output. Housed in a walnut cabinet 14" long, 6½" deep and 7½" high. Designed to install as a 5 wire system. If 5 wires are available, with the 2520 Master and 2520 Substations, Mode 5 wire, you can install an attractive, modern intercom system. Mode 5 wire. Stock No. 2520. Net price $24.95. Motice made a fortunate purchase and passes the bargain on to you. Shipping weight 12 lbs. Stock No. 2520. Net price $24.95 each.

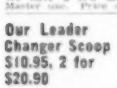
We have a few Model 2520, built for dealer to Master use. Price on Master Master $25.95.

Attractive walnut plastic cabinet, self-stick, for use with the model 2520 master. Has lever acting call back switch and Alnico 5" PM speaker. Net price $3.95 each. 5 for $17.50. 3 conductor electric intercom cable, $1.50 per 100 ft. $7.50, 1000 ft. $12.60.

HIGH FIDELITY OUTPUT TRANS. 20 20,000 CPS. Only $6.95
BEST VALUE IN U.S.A.
A-403—6000 ohms. Plate to Plate.

40-WATT OUTPUT "CAPEHART" HIGH FIDELITY $7.95

Stancor built for Capehart for this finest combination. Will work with all windings interwound to increase high frequency response and decrease eddy current losses. High inductance primaries for best efficiency at low audio frequencies. Push-pull high fidelity output transformer is fully shielded and has a net weight of 8 lbs. Made to match push-pull 6L6 tubes 5,000 ohms plate to plate. Secondary winding for 15½ feed back and 4 ohm voice coil. Stock No. A-4015. Net price ..... $7.95 shipping weight 8 lbs. Stock No. A-4016, for 20 cycles and above 20,000 cycles. Furnished with connecting instructions. Stock No. A-4016. Net price ..... $7.95 shipping weight 3 lbs., net $4.95



Our Leader Changer Scoop $10.95, 2 for $20.90

Our leader, automatic changer ready. Base size 13x15". Plays 10" 33⅓ RPM or 10" or 12" 78 RPM records automatically. Has Astatic L-70 cartridge. Priced complete with a base, ready to install. Shipping weight 20 lbs. Scoop price $10.95 each.

ARMCHAIR CABINETS FOR S-56 HALLICRAFTERS OR WITH BLANK PANEL $29.95

Armchair radio-phono combination cabinet, redesigned to house the S-56 Hallicrafters. Has 2 speaker openings, 14"x21" Hinged lid covers record changer compartment. Has roomy storage compartment and space for a record changer up to 14" square. Changer board cut to fit your changer. Metal tinsel and mounting holes cut for S-56 Hallicrafters. Cabinet is of top quality and furniture type finish. Shipping weight 40 lbs. Available in walnut, mahogany or blend.

Walnut cut for S-56. Net $29.95
Mahogany cut for S-56. Net 29.95
Blend cut for S-56. Net 34.95

PHONO NEEDLES

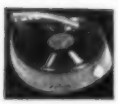
DUOTONE 99 Sapphires, 59c ea.; 10 for $4.95
DUOTONE Ruby with Bevel Brush 98c
DUOTONE NYLON, very popular $1.25
DUAL PURPOSE 3-Speed Needle, 1 for plays all 49c

MODEL CN-1232 12 INCH 25 WATT PM $5.95

Another McGee red hot special 12" 32 oz. Alnico 5 magnet PM speaker. 25 watt, 16 ohm voice coil speaker. A Made by Utah. Included: A $17.00 value. Ship. weight 8 lbs. Model CN-1232. Net price $5.95 each, 4 for $22.00

78 R.P.M. RECORD PLAYER $11.95

Self-Contained Amplifier. Speaker. Here is a real hot value. A complete self-contained 78 rpm record player with its own amplifier and speaker. It has a 3 tube amplifier. Alnico V PM speaker. Turn-over crystal pickup. The arm and speaker are contained under the attractive plastic hood. This is a complete record player that will give you more than you would expect for the price. Player is 10" x 13". Stock No. E-100P. Sale price, $11.95.



G.E. RECORD PLAYER ATTACHMENTS SALE PRICE **$6.95**

General Elec. 78 RPM Record Players add on attach to any radio or amplifier. Heavy duty motor and standard crystal pickup. Volume control and off-on switch. Ship. weight 8 lbs. Only for those with 78 RPM Model, Stock No. GE-78, $6.95. 33⅓ RPM Model, Stock No. GE-33 has Variable crystal pickup with needle. Net, $6.95. Buy 3 for $19.50.

S-56 HALLICRAFTERS

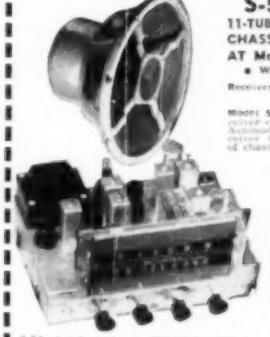
11-TUBE FM-AM CUSTOM CHASSIS. A $110.00 VALUE AT McGEE FOR ONLY . . . **$59.95**

- WIDE RANGE
- AUTOMATIC FREQUENCY CONTROL ON F.M.

Receives 88 to 108 MC F.M. and Broadcast 550 to 1650 K.C.

Fine for Custom Installation

Model S-56 Hallicrafters. 11 tube AM-FM radio receiver chassis for broadcast and FM use. 5 tube AM. Automatic frequency control on FM, holds the receiver in perfect tune. Phono connection on rear of chassis. Foil engraved front panel with base knob. Push-pull 6K6 tubes in audio output. Five speed tuning, Micrometer Reg. 540 kc. to 14,000 CPS. Wide vision accurately calibrated tuning. Tone dial, with compensation on broadcast band. Output transformer matches any 8 ohm speaker. 4 antenna terminals, for AM and two for FM. Uses 117 volts AC. This is the finest type of home radio that we have sold in years. Better get a set while they last. Designed to be used in commercial radio setting to the $500 to $600 class, but priced for the dealer set on this chassis at $110.00. However, a lucky purchase enables us to offer you this chassis for only $59.95. See larger illustration. Can be purchased S-56 Hallicrafters chassis, complete with cabinet and operating instructions. Stock No. S-56. Shipping weight 40 lbs. Net price $59.95



S-56 chassis with our $32.50 list 12" coaxial PM speaker, both for $69.50.

S-56 chassis with our Model P-15XC 15" coaxial speaker. Both for $75.95.

S-56 chassis with our new 12" curvilinear cone (1202-X) FM speaker, both for $67.95.

VM-950 Tri-O-Matic, 3 speed changer $28.35.

VM-950-GE, 3 speed changer with new GE RPX-050 V.R. cartridge $31.20.

Pre-amplifier for S-56 $3.95

Dual purpose preamplifier for either 2 mics or 4 mics to connect audition tone furnished. With this pre-amplifier you can connect to operate either a G.E. variable reluctance pick-up or crystal pickup to the same mic. making your 56 a home P.A. system. Preamp Model 56-PA. Stock No. 56-PA. Shipping weight 2 lbs. Net price. $3.95.

Crystal mike and desk stand, $4.95 extra.

V.M. 3 SPEED Record Changers

VM Model 407 deluxe 3 speed automatic record changer. Plays all sizes from all intermixed automatically. Changes the records of the same size and will flip over crystal pickup with twin needles. A new changer with a new design. Has a rubber mounted record changer. Ship. weight 14 lbs. Model 407. Net $35.28.

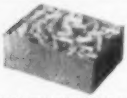
Buy the VM-950 changer with or without cartridge. Has the new VR cartridge. We think the VM-950 record changer is the finest in America. It automatically plays 7 inch records at 45 rpm, 10 inch, 33⅓ or 78 rpm, 12 inch, 33⅓ or 78 rpm, and 10 and 12 inch at the same speed intermixed. 12 in. 33⅓ or 12 in. 45 rpm. Automatically shuts off after the last record. Has built in 78 rpm turntable for high fidelity. Has 3 speeds. Has G.E. either with or without cartridge. VM-950, 3 speed changer with standard output crystal cartridge and needles for 78 and 33⅓ rpm records. Net $28.35.

VM-950GE, 3 speed changer with the new RPX-050 magnetic variable reluctance cartridge with stylus. Net $31.27.

VM-955, 5 speed changer with crystal cartridge in a base. Net $31.53.

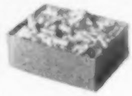
VM-955GE, 5 speed changer with RPX-050 VR cartridge and stylus, with base. Net $33.59.

McGEE OFFERS YOU BETTER RADIO PARTS VALUES AND HERE IS PROOF!



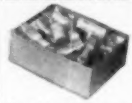
100 MOLDED PLASTIC BYPASSES $8.95

100 molded plastic tubular by-pass condensers. All 600 volt. And all by the same nationally known mfgr. Regular dealers net is over two and one half times our 20th Anniversary sale price. You'll chuckle when you look these over. Here's what you get: 10—.001, 10—.002, 20—.005, 20—.01, 20—.02, 10—.05 and 10—.1. Our big deal No. RN-202. 100 plastic tubulars. Shipping weight 2 lbs. Net price **$8.95.**



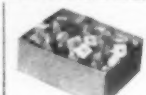
100 TOP QUALITY 600 VOLT TUBULARS $5.95

100 top quality 600 volt tubular by-pass condensers. Made this year by a famous condenser factory. Don't confuse these with grab bag surplus. McGee's deals are guaranteed to please you. Here's what you get: 10—.001, 10—.002, 20—.005, 20—.01, 10—.02, 20—.05 and 10—.1 600 volt condensers. Our big deal No. RN-203. Shipping weight 2 lbs. Net price **$5.95.**



20 50x30 MFD. 150 VOLT $9.75

Here's a red hot value. 20 of our XX quality replacement electrolytics. The most popular condensers in use today. Takes care of 90% of your AC-DC radio filter needs. Compact construction 1950 production. 1 year guarantee. 50-30 mfd. 150 volt, housed in a cardboard tube with common negative, has long flexible leads. 20th Anniversary, big deal No. RN-204. Sale price **$9.75.**



20 SELENIUM RECTIFIERS $9.95

20 top quality selenium rectifiers. Guaranteed 2nd to none. Latest compact construction. All standard 130 volt. Use these for your AC-DC sets when tubes are hard to get. 10-65 mil and 10-100 mil selenium rectifiers. McGee's big deal No. RN-208. Shipping weight 2 lbs. Net price **$8.95.**

10 OZ4 TUBES 10 4-PRONG VIBRATORS ALL FOR $16.95

Here's a red hot deal for you fellows that do a lot of auto radio service. 10 standard brand metal OZ4 tubes and 10 of our famous 4-prong serrated can vibrators. This vibrator is of the latest design, for long life. Standard diameter can, short enough to fit all Chrysler auto sets, also fits Motorola, etc. Our 20th Anniversary, big deal No. RN-V10. You get 10 OZ4 metal tubes and 10 4-prong vibrators, all for **$16.95.** Shipping weight 5 lbs.

20TH ANNIVERSARY SERVICEMAN SPECIAL

10 5-INCH P.M. SPKRS.
10 50x30 150 VOLT COND.
10 4-PRONG VIBRATORS
50 .01 600 VOLT
10 OZ4 TUBES
10 35Z5 TUBES
50 .05 600 VOLT
10 65 MILL SEL. RECTIFIERS

$49.95

Here is a real value for the radio repair man. All these parts listed are fast moving items. Fully guaranteed. Tubes are standard brand. The 5" PM speakers have 1 oz. magnet. The by-passes are all 1950 production. This deal is sold as a deal only and not broken up. A McGee 20th Anniversary special, deal No. RN-500. Net price **$49.95.**

SELENIUM RECTIFIERS

65 Mil Selenium Rectifier	49c
75 Mil Selenium Rectifier	59c
100 Mil Selenium Rectifier	59c
150 Mil Selenium Rectifier	73c
200 Mil Selenium Rectifier	99c
250 Mil Selenium Rectifier	$1.09

Mc Gee's XX quality selenium rectifiers, Small size, compact construction. All 1950 production, by a No. 1 factory. Not surplus, but uniform quality. Fully guaranteed. 130 volt RMS rated.

1 or 4 VOLT CRYSTAL CARTRIDGES $1.99

McGee offers you a famous make crystal cartridge. Standard size and shape, but very light weight. Will track on 3/4 oz. or more pressure. Stock A-6, 1/25 volt output, replaces Astatic L-70 etc., Net **$1.99.** Stock No. A-10, 4 volt output, replaces Astatic L-72 and L-82, etc., Net **$1.99.** Buy 10 assorted for **$19.00.**

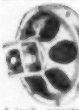
100 KNOBS Set-Screw Type $3.95

100 bakelite set screw knobs, for radio set replacement. All fit standard 1/4" shaft. Assorted walnut, black and ivory. Enough of each style to give you matched sets. This value worth **$7.50.** Shipping weight 2 lbs. Deal No. RN-10K, 100 knobs, Net **$3.95.**

BOES MODEL 103 REG. $7.77

SIGNAL TRACER PROBE. WHILE OUR STOCK LASTS

Boes signal tracer probe, with instructions. Made to sell to you for $7.77. McGee's sale price only **$2.95.** You get this: a heavy bakelite probe containing a 6F5GT tube. (The end of the probe is secured by three screws and may be taken apart easily.) A 5 foot lead with 3 circuit amphenol plugs and receptacle and Mueller peewee clip. You can connect this probe to any AC amplifier and have a signal tracer. Shpg. wt. 1 lb. Net, **$2.95; 2 for $4.95.**



CHOICE OF 4" or 5" P.M. SPEAKERS SALE PRICE $1.29

4 inch, square	1 oz. magnet	$1.29
5 inch, pincushion	1 oz. magnet	1.29
6 inch, pincushion	1.47 oz. magnet	1.79
4 x 6 inch	1 oz. magnet	1.69
5 x 7 inch, oval	1.47 oz. magnet	2.19
7 inch, pincushion	2.15 oz. magnet	2.95
8 inch, pincushion	2.15 oz. magnet	3.29
6 x 9 inch, oval	2.15 oz. magnet	2.95

McGee's fine quality line of replacement PM speakers. All have Alnico V magnets and standard 3.2 ohm voice coils. McGee has a tremendous stock of 100,000 speakers to fill your needs. Every speaker is fully guaranteed. Order your speakers now.

$19.95 BUYS A NEW St. George Wire Recording Mechanism

ONLY 200 TO SELL

McGee offers you at a terrific saving the St. George Series 1100, wire recording mechanism. Brand new and factory cartoned. This unit will record and playback from a standard recording wire, up to 1 hour. The wire take-up reel turns at 78 RPM and will play and record from a 78 RPM phono record. The base is punched for a phono pickup. Space required, 9x15x3 1/2". Shipped with a diagram of how to connect and also how to wire a 3 tube converter to enable the wire recorder to be used in conjunction with any radio or amplifier. St. George wire recording mechanism, Series 1100. Shipping weight 15 lbs. Net price **$19.95** each. Crystal phono pickup arm and cartridge **$1.95** extra. Recording wire: 15 minute spool. Net price **$1.19.** 30 minute spool. Net price **$1.79.** 1 hour spool. Net price **$2.79.** Crystal mike and desk stand **$4.95** extra.

G.E. BALL BEARING PICKUP $5.95

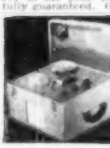
Precision Ball Bearing Arm—with separate 1 and 3 mil needles. For the critical music listener, who wants the finest microgroove tone arm built; we offer the General Electric, ball bearing tone arm Model UPX-004. It is equipped with a G.E. RPX-041 microgroove, variable reluctance cartridge with replaceable 1 mil sapphire stylus, for 33 1/3 or 45 RPM records. The arm is precision built with ball bearing mounting to give no drag on those valuable long playing records. Only 6 to 8 grams needle pressure. With each pickup we supply at no additional cost, a 3 mil G.E. sapphire needle, so that you may also use this arm on standard 78 RPM records. The total value of this combination offer is over **$11.00.** Shipping weight 1 lb. Stock No. X-0042. Sale price only **$5.95.** 3 speed motor and turntable (33 1/3, 45 and 78 RPM) **$5.49** extra.

G.E. RPX010 V.R. CART. $2.95

G.E. RPX010, with permanent needle, **$2.95** each; 10 for **$24.95.** Kit of parts to build 7F7 type preamplifier, **$2.49** extra. A lucky purchase by us enables this terrific General Electric cartridge value.

DYNAMIC MIKE $9.95

Our leader dynamic mike Model D-4. Our leader high impedance dynamic mike. Shipped with 12 ft. cable. Very special at **$9.95** each. Top Quality Chrome Floor Mike Stand, **$5.95.**



1950 MODEL PORTABLE TAPE RECORDER $79.95

Our brand new 1950 model portable tape recorder. Response, 60 to 8,000 CPS. With this you make and play-back top quality tape recordings. Tape speed, 7 1/2 feet per second. New mechanism records 1 hour on 1200 ft. reel of tape. Fast rewind. Record 30 minutes, turn spool over and record second 30 minutes on 1200 ft. reel. Has an AC transformer type amplifier with 6" speaker. Inputs for mike and radio. External speaker jack. Price includes 30 minute reel of tape and mike. Hinged lid is removable. Case is attractive leatherette covered. Size 10x13x14". Shipping weight 29 lbs. Stock No. PLT-3. Net price **$79.95.**

Wire Recorder Converter FOR ANY WIRE RECORDER MECHANISM $12.95

Wire recorder converter **$12.95.** With this 3 tube converter you can adapt the St. George, Air King, or Webster Chicago wire recorder mechanism to any radio or amplifier. Only 3 connections necessary. Just plug in to the phono input of your amplifier and connect to plate of output tube. AC transformer construction, gain for mike, 3 position switch for quickly changing from record to playback. Priced ready wired and tested with instructions and tubes; 12AT7 preamplifier, 6AQ5 oscillator erase and 6X4 rectifier. Model RR-Y, shpg. wt. 6 lbs.

STANDARD BRAND RADIO TUBES—CARTONED AND UNCARTONED G T G AND MINIATURES AND LOCTALS

59c each: OZ4, 1C6, 1F5, 1G4, 1L4, 1S5, 1T4, 1T5, 2A5, 5U4, 5Y3, 5Y4, 6A8, 6C5, 6H6gt, 6J7, 6K7, 6Q7, 6SF7, 6SH7, 6SJ7, 6SK7, 6SS7, 6X5, 7A4, 7A5, 7A6, 7A7, 7B4, 7B6, 7B7, 7B8, 7C4, 7C5, 7C7, 7E7, 7F7, 7H7, 7L7, 7N7, 7Q7, 7S7, 7Y7, 7Y4, 7Z4, 12A8, 12J5, 12J7, 12K7, 12K8, 12Q7, 12SC7, 12SF5, 12SG7, 12SH7, 12SL7, 12SN7, 14B6, 14C5, 14F7, 14H7, 14N7, 14Q7, 14R7, 24, 25Z6, 27, 35, 35W4, 35Z5, 43, 47, 50Y6, 56, 57, 58, 76, 6SQ7, 12AT6, 12SQ7, 117Z6, 1LG5, 1LN5, 3LF4, 5T4

69c each: 1A5, 1Q5, 3Q4, 3S4, 3V4, 5Z3, 5Z4, 6AT6, 6SL7

79c each: 1H5, 5W4, 6SA7, 1LA4, 1LC5, 1LC6, 1LD5, 1LE3

89c each: 6BA6, 6BE6, 12BA6, 12BE6, 12SA7, 12SK7, 35L6, 50L6

94c each: 1A7, 1N5, 1R5, 3S4, 3V4, 6AQ5, 6V6, 12AU6, 35B5, 50B5

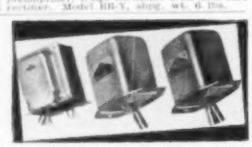
The above list is not all of the tubes that we have in stock. We will give you standard brand tubes not listed, as follows:

List	Price
$1.25 list	59c
1.50 list	69c
1.65 list	79c
$1.80 list	89c
2.00 list	94c
2.40 list	$1.14
$2.65 list	$1.25
2.90 list	1.37
3.20 list	1.52

BROADCAST QUALITY TRANSFORMER KIT

Response 18 to 22000 C.P.S. The Same Quality as Used in the Finest Quality Audio Amplifiers

Why Pay More Sale Price $12.95



Here is the hottest transformer kit we have ever offered. Originally intended for use in the high priced Leas recorder amplifier. Made of the best possible material to give broadcast station frequency response; 18 to 22,000 CPS. A suggested diagram is furnished to build your own amplifier; with inputs for G.E. variable reluctance phono pickup, crystal phono pickup or radio tuner. Here are the transformer specifications: The output is a compound filled case, 3 x 2 1/2 x 3 1/2" high, weight 2 1/4 lbs., response 18 to 22,000 CPS, matches 2—6V6 in push-pull (15 watts), output taps match 4 or 8 ohm speaker. The power transformer is a fully shielded upright model, 3 1/2 x 4 1/2 x 4 1/2" tall, weight 8 1/4 lbs. This transformer is utilized in a full wave selenium rectifier bridge, easy to hook up, full details included, which relivers 300 volts at 200 mils, with the best possible voltage regulation. Also has a 6.3 volt 5 amp. filament winding. The selenium rectifiers come with this kit. The choke weighs 2 1/4 lbs. and is the same size as the output. You get full description of the kit, including a suggested schematic. You supply the other parts. We furnish the power transformer, choke, output and rectifiers. Shipping weight 15 lbs. Stock No. TD-1822. Net price $12.95

ILLUSTRATED 2 TWEETERS GROUPED WITH 2 10" WOOFER SPEAKERS AS PICTURED ALL FOR $28.95

High Frequency Tweeter Speaker

RESPONSE 750 CPS TO ABOVE 17,500 CPS

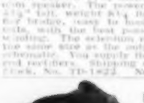
WHY PAY MORE THAN $9.95 FOR A GOOD TWEETER

Why pay $20 to $25 for a tweeter. McGee's 1951 model high frequency speaker, designed for reproduction of the higher audio frequencies from 750 to above 17,500 CPS. Use this with any high quality cone speaker, 10, 12 or 15". It is simple to connect. Merely use a 2 mfd. paper condenser in series with this high frequency speaker and connect across the voice coil of your woofer. This capacitor prevents the lower frequencies, below 750 CPS from reaching the high frequency speaker (tweeter). When connected in this manner, it can be used on any amplifier up to 30 watts. A good PM 10, 12 or 15", used with this tweeter will reproduce music with fine naturalness. Tweeter impedance is 8 ohms. Ordinarily a tweeter of this quality would sell up to twice our price. Don't confuse this with small tweeters, that only reproduce down to 1500 or 3000 CPS. This is a fine job made of spun aluminum, with removable 8 ohm Alnico driver. Bell diameter 4 3/4", overall length 10 3/4". Shipping weight 3 lbs. Stock No. HF-5 high frequency speaker (tweeter), Net **$9.95** each; 2 for **$19.00.**

HF-5 tweeter and our CN-1232, 12" 32 oz. PM speaker, both for **$15.45.** 2 mfd. capacitor to connect tweeter, **50c** extra. Two of our 1025PS, super quality 10" PM speakers and two of the HF-5 tweeters all for **$28.95.** This combination will take 30 watts and will sound beautiful.

1 No. 1025PS, 10" PM speaker and 1—HF-5 tweeter, both for **$14.50.**

1 our Model No. 15-SB, 15" PM and 1—HF-5 tweeter, both for **$19.95.**



RECORD PLAYER KIT $9.95

Complete record player kit, for 78 RPM records. All parts, tubes and diagram for building a 70L7 type amplifier. Attractive ready cut walnut base speaker cutout on top. Ballentone phono motor and Astatic pickup with permanent needle. Shipping weight 10 lbs. Model No. MD-78. Net price **$9.95.**

Three-speed model No. D-3378, same as above only has 3 speed motor and fly weight crystal pick up arm with Universal 3-speed needle. Net price **$13.95.**

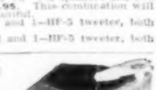
5-TUBE UTILITY CHASSIS $9.95

Small 5 tube AC-DC radio chassis built by Farnsworth, but they never got around to putting them into cabinets. Uses conventional tube line up; 12SA7, 12SK7, 12SQ7, 50L6, 35Z5. Loop antenna. No dial system furnished. But it has transparent push on knobs calibrated for stations. Receives broadcast, 530 to 1650 KC. Has Alnico V PM speaker attached to chassis, which is regular small size. Use this to mount in your kitchen cabinet, etc. Only 100 to sell. Stock No. AF-5, with tubes shipping weight 5 lbs. Net **$9.95.**

BUY THIS FOR THE KIDS SALE PRICE $18.95

3-SPEED RECORD PLAYER-RADIO

WHY BUY JUST A RECORD PLAYER?



For the recreation or children's room. Buy this radio, 3 speed record player, at the usual price of the player alone. It has 3 speed phono motor, dual purpose crystal pickup (33 1/3-78-45 RPM). Top quality Farnsworth built AC-DC broadcast superhet radio chassis; full 5 tubes with loop antenna. Pilot lite shines through transparent knobs. A special purchase makes these 200 available. To keep the cost down, we leave the bolting of the chassis in the cabinet to you. No special tools required and it can be done in less than an hour. The chassis is complete with tubes and an Alnico V PM speaker. It was wired in the Farnsworth factory. Stock No. JA-75. Shipping weight 16 lbs. Children's radio and 3 speed record player. Net price **$18.95.**

McGEE RADIO COMPANY Prices F.O.B. K.C. Send 25% Deposit with Order, Balance Sent C.O.D. With Parcel Post Orders, Include Postage. **TELEPHONE VICTOR 9045. WRITE FOR FLYER 1422 GRAND AVE., KANSAS CITY, MISSOURI**

Safety Switch Plus

Build safety into your ham shack by installing this unit as a main a.c. outlet for transmitter.

By JAMES KAUKE

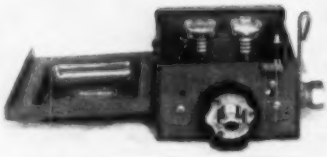


Fig. 1. Bottom view of the safety switch showing power outlet plug in position.

THE importance of safety in the radio amateur's ham shack cannot be over-emphasized. One of the most important precautions which can be taken is in the matter of the installation of a safety switch as a main a.c. outlet for transmitter power. When making a.c. power available in the shack it is an easy matter to provide room for such features as BCI and TVI filter accessories, fusing in the radio room, and a disconnect that makes a positive cabinet ground.

Commercial and military installations usually employ extensive bonding and grounding with various provisions being made for the safety of the apparatus and personnel. The ham radio transmitter should be installed in conformance with good commercial practice.

An inspection of the *Underwriters' Laboratories'* recommendations shows that No. 12 AWG wire will handle 20 amperes. At 220 volts, one should have plenty of copper for that ultimate "full gallon" transmitter. In my case I am running 500 watts' input or less on radiophone and fusing the 110 volt a.c. service at 15 amperes.

A group of enclosed, fused switches, rated at 30 amperes, was inspected and although most of them would do, I kept in mind the fact that a little extra room would allow the desired disconnect and a chance to include filtering. The Palmer* Type O switch (see Figs. 1 and 2) was ultimately chosen upon the recommendation of a wiring inspector. The Type O makes provision for a lock to prevent accidental opening of the switch box and its attendant danger of shock to the junior members of the family. The switch can be locked in the "off" position to prevent unauthorized use of the rig.

Three wires are desirable. One wire should be available to make the first circuit to ground the transmitter and two wires are needed to carry the a.c. despite the polarity encountered or the fused grounds in the wiring circuits. Since I prefer plugs that don't fall out just as I get ready to operate, I selected "Twist Lock." The plug is the Type No. 9965 *Hubbell* unit and the receptacle is the Type 7310-B, as shown in Fig. 3.

It is possible to have two receptacles, if desired, but since the line is fused for one transmitter and since one transmitter at a time should be sufficient, one receptacle is used at W1DFS.

The safety switch is mounted about 24 inches from the floor and along-

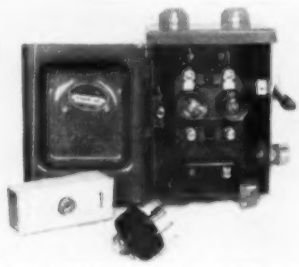
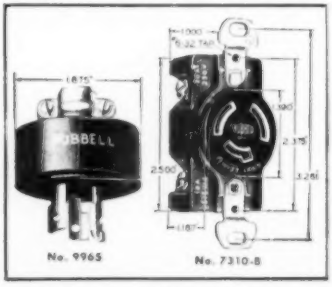


Fig. 2. Safety switch and fused disconnect with space for r.f. filtering unit.

side of the main transmitter. A second rig, which may see completion in the future, will find room on the other side of this switch. The switch is just large enough to make it conspicuous in case of trouble.

The circuit can be varied to suit the individual user. My unit is installed in accordance with Fig. 4. Three wire

Fig. 3. The Hubbell plug and receptacle.



*Catalogue No. 2123, The Palmer Electric & Mfg. Co., Wakefield, Mass.

OCT. SPECIAL
2" SIMPSON 0-500 MICROAMP. BASIC, VOLT SCALE
$2.95 EA.

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FILTER CHOKE
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120 OHMS
$1.49 EA.

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BRAND NEW Government Surplus

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2" Simpson 0-5 Ma Basic, Square	2.25
2" Simpson 0-20 Ma (Amp Scale)	1.95
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2" Sun 0-50 (0-100 Scale) Square	1.95
2" G.E. 0-50 Ma	2.50
2" G.E. 0-250 Ma AC	2.95
2" G.E. 0-1 Amp RF (Internal Thermo)	1.95
2" Simpson 0-2 Amp RF (Internal Thermo)	1.95
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2" Triplett 0-300V AC	2.95
2" GE 0-30 Amps DC (Internal Shunt)	1.95
3" G.E. 50-0-50 Microamps	3.95
3" G.E. 0-75 Microamps	12.50
3" McClintock 0-1 Ma DC (0-10 Scale)	3.95
3" Westinghouse 0-1 Ma (KV Scale) Square	3.95
3" Westinghouse 0-2 Ma	3.95
3" G.E. 0-5 Ma, Square Case	3.95
3" Westinghouse 0-10 Ma (Amp Scale)	2.75
3" G.E. 0-10 Ma, Square Case	3.95
3" Westinghouse 0-15 Ma	3.95
3" Westinghouse 0-20 Ma	3.95
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3" G.E. 0-1 Amp DC, Square Case	3.95
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3" G.E. 0-2 Amp DC, Square Case	3.95
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3" G.E. 0-3 Amp DC, Square Case	3.95
3" G.E. 0-15 V AC Square Case	3.95
3" Weston 0-1 V DC	3.95
3" G.E. 0-300 V DC (1000 ohms V)	4.50
3" Westinghouse 0-750 V DC (1000 ohms V)	4.50
3" G.E. 0-800 V DC (1000 ohms V)	4.50
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3" G.E. 0-200 Microamps, Square	9.95
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LINK TEST SET
Type #1410. Contains two 3½" meters—a 75-0-75 microamp Galvanometer and a 0-1 MA multi-scale meter. Has tap switch for changing range. Ranges are as follows: 75-0-75 microamps, 1 MA 2.5 MA, 50 MA, 25 volts, 500 volts. Ideal for balancing dissimilators and other lab use. Housed in hard wood case with hinged cover. 10" x 8" x 6½". Only ..... $14.95 ea.

GUARDIAN LATCHING RELAY
Type RC 100. 110 volt 60 cycle coil. S.P.D.T. each impulse reverses the position of the contacts. Locks automatically. Contacts rated 1500 watts at 110V 60 cycles. Size 3" long, 2⅛" wide, 1½" high. Only ..... $1.95 ea.

HIGH WATTAGE ANTENNA RELAY

110 220 volt 60 cycle solenoid D.P.D.T. rated at 5000V, 15A. Heavy duty paralleled contacts. Sturdy construction. Isolantite insulation. Base 8" x 3" x 3½". Made by Monitor Controller $18.50
Same specs. as above, but DPST $12.50
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Breaks at 3 MA. Beautifully Constructed and delicately pivoted. Approx. 2000 ohms resistance. Housed in dustproof aluminum case. Plugs into 5 prong socket. Only ..... 99c ea.

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Delicately balanced, S.P.D.T., 10,000 ohm coil. Trips at .4 to .5 MA. 2⅛" x 2⅛" x 1⅝" high $2.95

GENERAL ELECTRIC OVERLOAD RELAY. ELECTRICAL RESET 110 VOLTS 60 CYCLE
Breaks at 640 Milliamps but easily adjustable for other currents. Terrific values at only $1.95

GENERAL PURPOSE TRANSFORMER
Ideal for Bias, Isolation, Stepdown, etc. 2 isolated 110v pr. primary 110v at 900 ma sec. ..Now $1.49 ea.

PIGTAIL MICAS
MMF: 5, 20, 50, 60, 100, 250, 300, 400, 500, 750, 800, 1000, 2000, 3000 ..... $0.08 ea.

PANEL METER KIT
Here's what you get
- 2" Sq. bakelite cased meter, Govt. Surplus
- Scales for all the following ranges:
  0-50 ma, 0-100 ma, 0-200 ma, 0-500 ma.
- Pre-calculated shunts for all the above ranges.
- Complete instructions.

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THORDARSON PLATE TRANSFORMER
CHT Series, Model T15P 22. 110-220 volt 60 cy. Primary: 3500V, 3000V, 2500V, 2000V C.T. Secondary: 625 watts. Weight 70 Lbs. ..... $22.50 ea.

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Pri. 115 volts, 60 cycles. Sec. 4400 volts RMS 4.5 MA., 5 volts, CT 3 amps. Fil. ins. 15 KV. RMS test. Hermetically sealed. Has insulated plate cap for rectifier. Made by Raytheon. 4½ x 5 x 5½ ..... Only $3.95

Mallory Vibropack Transformer 6 Volt Input. Output 300 Volts at 100 MA $1.95

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Hermetically sealed. Oil Immersed Full Wave Bridge. 30 Volts AC Input. 24 Volts at 2 Amps Output. Size 2⅝x2⅝x3⅞ ht. ..... $3.75 ea.

50 megohm 35 watt Resistor with mount. $1.49 each; 10 for $9.90.

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30 WATT WIRE WOUND RESISTORS
Ohms: 100-2500-3k-4k-4500-5k-5300-18k ..... 8 for .99

Precision 15 Meg. 1% Accuracy Resistor, Noninductive, 1 watt, hermetically sealed in glass .25 ea. 10 for $1.90

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.6	mfd	600 vdc	.79	2 mfd	4000 vdc	4.90
.5-.7	mfd	600 vdc	.79	4 mfd	4000 vdc	6.95
.8/.8	mfd	600 vdc	1.39	1	mfd 5000 vdc	3.95
10	mfd	600 vdc	.89	.1/.1	mfd 7000 vdc	2.25
4	mfd	1000 vdc	.95	2	mfd 6000 vdc	9.95
10	mfd	1000 vdc	2.50	1	mfd 7500 vdc	6.50
2	mfd	1500 vdc	1.25	.01/.01	mfd 12 kv	5.75
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10	mfd	1500 vdc	3.75	.65	mfd 12,500 vdc	12.95
1	mfd	2000 vdc	1.45	1	mfd 15 kv dc	13.90

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6.3V @ 12A $1.69
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PRECISION 1% W.W. RESISTORS
Ohms: 2K, 2500, 5K, 8500, 50K, 95K, 750K. $0.25 ea.

POWER TRANSFORMER
550 Volts CT, 125 ma. 5 V. @ 2A, 6.3 V @ 4A Pri 117 V 60 cy. Fully cased ..... $1.95 ea.

POWER SUPPLY KIT
Uses transformer described and illustrated plus (1) 150 ma choke, (1) dual oil capacitor, and (1) socket. All for only $2.99

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Pri 110 V 60 cy. Sec 880 V CT @ 100 ma. 6.3 V @ 4 A, 5V @ 3 A. Fully cased ..... $2.49 ea.

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175V 50 Ma. ..... $0.69 ea.
940 volts CT 125MA, 6.3V 8A, 6.3V, 2.5A, 6.3, 1.2A, 6.3V, .5A, 5V, 3A ..... 3.95 ea.
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300 volts CT 300 MA, 2.5V7A, 2.5V7A, 6.3V, 1.5A. 2.75

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6 Henry 50 ma 250 ohms, open frame ..... 3 for	$0.99
6 Henry 80 ma 220 ohms, open frame	.69
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6 Henry 400 ma 97 ohms, fully cased	3.49
4.3 Henry 445 ma 39 ohms, fully cased	4.25
10 Henry 350 ma 125 ohms, tapped, full case..	2.95
15 Henry 250 ma 290 ohms, tapped, full case..	2.20
20 Henry 36 ma 350 ohms, fully cased	.69
12 Henry 250 ma 190 ohms, fully cased	2.00
5 Henry 170 ma 110 ohms, fully cased	1.35

HIGH CURRENT MICAS
Type G4 Ceramic Case 5¼" High, 5" Diameter Tolerance 5% or Better.

CAP MFD	Amps I Mc	KV DC	Price Each	CAP MFD	Amps I Mc	KV DC	Price Each
.08	60	4	$27.50	.009	4	15	$29.50
.1	70	6	29.50	.01	43	15	29.50
.05	60	5	24.50	.0025	25	20	29.50
.027	45	6	29.50	.0014	25	20	29.50
.012	40	9	29.50	.004	50	22	33.50
.02	55	10	29.50	.0075	25	25	35.50
.0117	40	14	24.50	.001	12	20	27.50
.0053	25	15	24.50	.0005	10	20	27.50
	TYPE G1				TYPE G2		
.00054	4	6	$3.95	.001	10	10	$5.95
.0003	4	6	3.95	.002	13	10	5.95
.0005	5	6	3.95	.01	22	7	6.95
.001	7	6	4.95		G3		
.002	11	6	4.95	.001	14	20	14.50

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MMF	VDC	Price	MMF	VDC	Price
B .001	600	$ .18	C .001	3 KV	$ .90
E .01	600	.26	C .002	3 KV	.95
B .02	600	.26	B .005	3 KV	.70
B .05	600	.26	C .005	3 KV	1.25
C .01	1 KV	.45	C .006	3 KV	1.50
C .07	1 KV	.55	D .002	3 KV	.70
B .02	1250	.35	C .0001	5 KV	.70
C .014	1500	.65	C .0015	5 KV	.65
C .033	1500	.75	C .0015	5 KV	1.60
C .015	2 KV	.80	C .003	5 KV	1.50
C .02	2 KV	.90	C .005	5 KV	2.50
B .002	2500	.45	C .0022	5 KV	2.90
B .005	2500	.55	B .002	8 KV	5.95
C .025	2000	1.25	B .0075	8 KV	2.90
			B .0012	8 KV	4.50

NON INDUCTIVE RESISTORS
250 ohm 100 watt $0.75
500 ohm 100 watt ..... .75
12500 ohm 150 watt ..... .95

METER MULTIPLIERS
2 Meg 1.5 of 1% Cage enclosed 2 KV $3.95
2 Meg ½ of 1% Tubular 2KV 1.95
4 Meg ½ of 1% Tubular 4KV 3.75

IN21B SILICON DIODES, $0.35 ea.; 10 for $2.90

HEAVY DUTY CERAMIC RF SWITCH
Single Pole 11 pos. ..... $0.99 ea.

UTC type PA 5000 ohm plate to 500 ohm line and 6 ohm voice coil. 10 watt, 60 to 10,000 cps. 1 DB. CLOSE OUT AT $1.99

SOLAR CONSTANT VOLTAGE
Pri. 95-125 Volt—Sec. Output 115V 2000VA Single Phase. Wt. 250 lbs. List $250. OUR LOW PRICE $134.50

MOSSMAN SWITCHES
4 Pole Single Throw $0.95

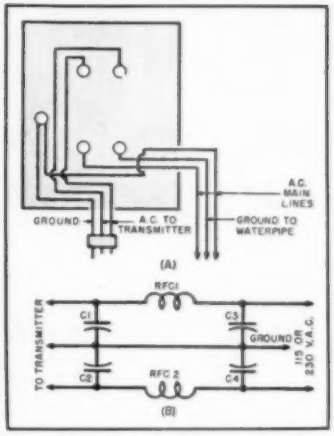

Fig. 4. Method for installing safety switch.

Three (No. 12 wires) connect the plug to the transmitter proper to complete the installation. This allows changes in the transmitter or changing to another rig at a later date, but there is ample copper to deliver the a.c. power needed and the rack is automatically grounded.

Filtering

Unfortunately filtering is difficult to standardize. Rigs, conditions, and fortune seem to vary. However, there is room for condensers and r.f. chokes in the upper portion of the steel cabinet. In my case two .01 μfd., 600 v. (1200 volt test) mica condensers were all that were needed. There is room for a 1 inch form about 4½ inches long to accommodate a dual-wound r.f. choke in addition to four mica condensers if needed. It is suggested that tests be made as the ultimate circuit will depend on the rig and installation.

Switch to safety before it is too late! Many have talked about it—now is a good time to do it!

—30—

"All right! Come down to the first row and do your drinking! I had one fellow fall off the high stool and break his leg!"

NIAGARA--ONE OF AMERICA'S GREAT ELECTRONICS STORES

DOES YOUR TV SET DROOP FROM INTERFERENCE BLOOP

Banish interference with Niagara's Hi-pass filter! Positive protection against interference from amateur transmitters, diathermy, and all other devices generating radio frequency interference below 40 MC's. Designed for 300 ohm leads. No loss in brightness or clarity. Available built up or in easy to assemble kit form. Complete instructions and test report included. Hi-pass filter

Kit $1.95

Wired and tested 2.95

Plus 15c postage and handling in USA. Money back if not satisfied.

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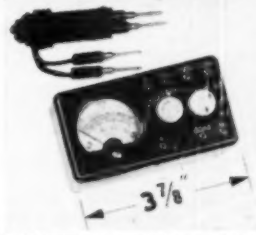

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- 0-150 DC MA.
- 0-100,000 ohms

Ohms adjust and 10-AC-OHMS switch. Includes 1 pair test leads. Will fit into your which pocket. Fully guaranteed.

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SMASHING REDUCTION PHILCO R.F. SIGNAL GENERATOR

Model 7070

Designed for precision alignment and many other tests. Max. frequency stability, ample output, portable.

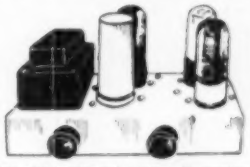
6C4 RF osc.—⅓ of 7F8 cathode follower—½ of 7F8 audio osc. —6X5GT rect. Six bands of RF from 100 KC to 110 MC. ALL FUNDAMENTALS.

Calibration accurate to within 1% of scale. Complete with shielded output lead and instruction book. 110 V. 60 cycle AC only. 20 lbs. A $185.00 value, used, like new, for only $39.95

SPECIAL SCOOP ARC 5 R—28 2 METER RECEIVER

HOTTEST 2 METER RECEIVER available today. 4 channel XTAL controlled with relays, easily converted. Covers 100—156 MCS. Supplied with all tubes, 4—717A, 1—12A6, 3—12SH7, and 2—12SL7 gt. Originally $65.00. Brand new—original cartons $19.95

5 WATT AUDIO AMPLIFIER



Complete with speaker and 3 tubes. Hi-impedance output for XTAL, Crystal or Phono-Pickup. Volume and tone controls. 5 W. amplif. with 8" speaker $8.95

Same as above with 9" speaker 9.95

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2E25A 4.25	4E29 ..... 110.00	114A ..... .69	527 ..... 6.50	836 ..... 1.25	1630 ..... .49	FG105 ..... 9.50	RK73 ..... .65
2E26 ..... 3.95	5AP1 ..... 1.85	114B 1.25	531 ..... 4.95	837 ..... 1.50	1631 ..... 1.35	FG166 ..... 49.50	RX21 ..... 3.10
2E30 ..... 2.39	5AP4 ..... 1.85	120 ..... 5.95	532A 4.95	838 ..... 2.25	1633 ..... .75	FG172A 13.75	RX120 ..... 6.75
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2J50 ..... 29.50	5JP1 ..... 24.50	250TH 19.50	713A 1.00	876 ..... .28	2000T 125.00	HF210 ..... 12.95	WL400 ..... 14.95
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2J54B 24.95	5LP1 ..... 11.95	259A 4.95	715A,B 6.75	884 ..... 1.49	2051 ..... .40	HK254 ..... 12.95	WL532A 1.75
2J55 ..... 24.50	5LP5 ..... 14.50	274B 1.00	715C 22.50	885 ..... .98	5514 ..... 4.95	HY18 ..... 12.95	WL562 ..... 150.00
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2AP1 ..... 4.75	6AS6 ..... 2.89	286A 10.95	723A,B 2.95	905 ..... 2.75	8005 ..... 4.60	HY1269 ..... 2.75	ZB3200 ..... 150.00
3B22 ..... 2.50	6C21 ..... 24.95	287A 9.95	724A,B 2.75	922 ..... 1.00	8011 ..... 2.00	HYE1148 ..... .35	
3B23 ..... 4.95	6F4 ..... 5.95	290A 4.95					
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3B24W 2.95	7BP1 ..... 4.95	294A 4.50					

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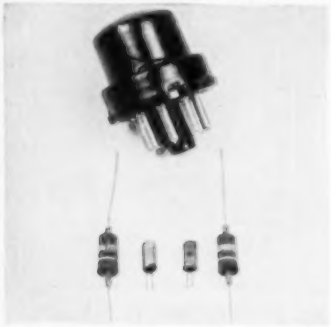
What's New in Radio

For additional information on any of the items described herein, readers are asked to write direct to the manufacturer. By mentioning RADIO & TELEVISION NEWS, the page, and the issue number, delay will be avoided.

GERMANIUM DIODES

The *General Electric Company*, Syracuse, New York, has announced the addition of five new types of germanium units to its line.

Included are two new transistors the types SX-4A and Z2, which use a metal case with two silver-plated



phosphor bronze connecting pins. Eacn of the type SX-4A units is checked for power gain of between 13 and 20 db. with .1 volt input at 5 kc. Maximum ratings are: emitter d.c. current of 1 ma.; collector d.c. current of 2 ma.; and emitter r.m.s. signal of .3 volt. The Z-2 units are checked for characteristics suitable for trigger circuits.

The types 1N69 and 1N70 germanium diodes, built to JAN specifications, have also been added to the line. Both feature a new rugged mechanical construction for either solder or clip-in mounting.

The fifth of the new units is the *G-E* Quad, type G-9, which is a combination of specially selected germanium diodes with matched characteristics. The diodes are hermetically sealed in a compact metal radio tube shell with standard octal base.

FREQUENCY STANDARD

A new frequency standard, the Model SF50-A, is currently being mar-

keted by *Rex Bassett, Incorporated* of Fort Lauderdale, Florida.

This instrument is a compact, temperature and crystal controlled, r.f. standard generator in combination with a high accuracy audio interpolation oscillator. The r.f. section provides output which can be accurately synchronized with WWV on 10 kc. and all multiples thereof, and is useful up to and beyond 160 mc.

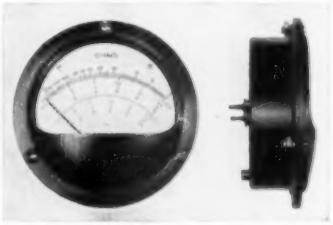
The audio frequency section provides continuously variable a.f. output throughout the range of 50 c.p.s. to 6000 c.p.s. A built-in panel loudspeaker is provided for monitoring of the interpolation oscillator and terminals are located on the chassis for connection to an external oscilloscope or counter panel.

In addition to its primary function as a frequency measuring device, the instrument may be employed for purposes of alignment, distortion checking, and amplifier gain adjustment.

PANEL METER

A 4½ inch, hermetically-sealed panel meter has been added to *Marion Electrical Instrument Company's* line as the HM 4.

This new and compact meter, which is only 1⅛ inches in depth, is provided with a solder type zero adjuster which permits adjustment without breaking the hermetic seal. A rubber gasket is



included for use as a pressure seal for panel mounting.

Either 1% or 2% accuracy rating is available. Dials are standard or specially calibrated, depending on requirements. Full details on the HM 4 are available from the company at Manchester, New Hampshire.

NEW SPEAKER

University Loudspeakers, Inc. of 80 South Kensico Avenue, White Plains, New York, has developed a new 12" wide-range cone speaker for television replacement work, high-fidelity audio equipment, p.a. systems, and auditorium sound applications.

The Model 6200 covers the frequency range up to 10,000 cycles at 30 watts continuous power. The speaker incorporates an exclusive "W" shaped 1½ pound Alnico V magnet with a

(*Continued on page 99*)

4 Pages of TEST EQUIPMENT
at prices every serviceman can afford!

MONEY BACK?

Every single unit described on this and the following pages is offered on a strict "money-back-if-not-satisfied-basis." No if's—no but's—no maybe's. Simply send your order for any unit or units you select and try them out for 10 days. If not completely satisfied—return for refund in full. No explanation necessary. You are sole judge.

GUARANTEE?

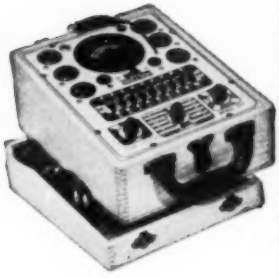
Every instrument sold by us is covered by a one-year guarantee. Guarantee registration card is included with shipment.

KITS?

We have discontinued advertising TEST EQUIPMENT in Kit form. The units offered on these 4 pages are completed instruments, NOT KITS! Every model is factory-wired, calibrated and ready to operate.

TUBE TESTERS

THE NEW MODEL 247



Check octals, loctals, bantam jr., peanuts, television miniatures, magic eye, hearing aids, thyratrons, the new type H.F. miniatures, etc.

Features:

★ A newly designed element selector switch reduces the possibility of obsolescence to an absolute minimum.

★ When checking Diode, Triode and Pentode sections of multi-purpose tubes, sections can be tested individually. A special isolating circuit allows each section to be tested as if it were in a separate envelope.

★ The Model 247 provides a supersensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals.

★ One of the most important improvements, we believe, is the fact that the 4-position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

$29.90 NET

Model 247 comes complete with new speed-read chart. Comes housed in handsome hand-rubbed oak cabinet sloped for bench use. A slip-on portable hinged cover is indicated for outside use. Size: 10¼"x8¾"x5¾".

SUPERIOR'S NEW MODEL TV-10

★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing-Aid, Thyratron, Miniatures, Sub-Miniatures, Novals, etc. Will also test Pilot Lights.

★ Tests by the well-established emission method for tube quality, directly read on the scale of the meter.

★ Tests for "shorts" and "leakages" up to 5 Megohms.

★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-10 as any of the pins may be placed in the neutral position when necessary.

★ The TV-10 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

★ Newly designed Line Voltage Control compensates for variation of any line voltage between 105 Volts and 130 Volts.

★ Free-moving built-in roll chart with complete data on all tubes.

The Model TV-10 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

$39.50 NET

TO ORDER—TURN TO PAGE 98 FOR RUSH ORDER FORM

GENERAL ELECTRONIC DISTRIBUTING CO.

DEPT. RN-10, 98 PARK PLACE NEW YORK 7, N. Y.

1

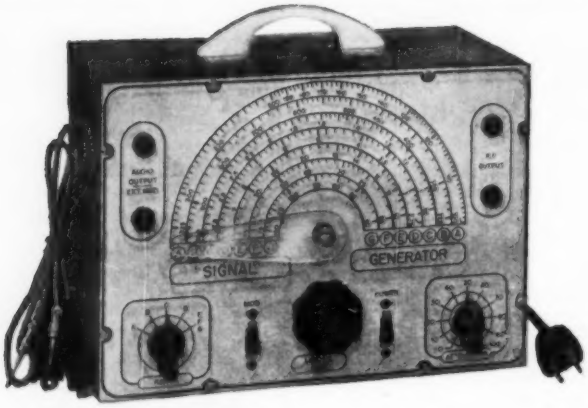
BUY WITH CONFIDENCE!!

WE KNOW THE PRICE IS UNBELIEVABLY LOW. . .

But that's not all! In addition, this finely engineered instrument provides a degree of accuracy never before attained in a unit selling for even double this price. Furthermore—in designing this unit, we took advantage of every recent improvement in components. For example, by using slug-tuned coils, we are able to efficiently adjust each instrument for perfect accuracy. This feature will also enable you to recalibrate the model 200 periodically without having to return it to the factory. The use of a Noval tube (the 12AU7) with its extremely low inter-electrode capacity enabled us to reach a higher frequency range than was heretofore possible in a unit of this type.

THE NEW MODEL 200 **AM and FM**

SIGNAL GENERATOR



SPECIFICATIONS

★ **R.F. FREQUENCY RANGES:** 100 Kilocycles to 150 Megacycles.

★ **MODULATING FREQUENCY:** 400 Cycles. May be used for modulating the R. F. signal. Also available separately.

★ **ATTENUATION:** The constant impedance attenuator is isolated from the oscillating circuit by the buffer tube. Output impedance of this model is only 100 ohms. This low impedance reduces losses in the output cable.

★ **OSCILLATORY CIRCUIT:** Hartley oscillator with cathode follower buffer tube. Frequency stability is assured by modulating the buffer tube.

★ **ACCURACY:** Use of high-Q permeability, tuned coils adjusted against 1/10th of 1% standards assures an accuracy of 1% on *all ranges from 100 Kilocycles to 10 Megacycles* and an accuracy of 2% on the higher frequencies.

★ **TUBES USED:** 12AU7—One section is used as oscillator and the second is modulated cathode follower. T-2 is used as modulator. 6C4 is used as rectifier.

The Model 200 operates on 110 Volts A.C. Comes complete with output cable and operating instructions.

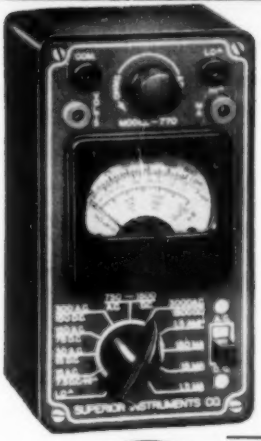
$18.85 NET

TO ORDER—TURN TO PAGE 98 FOR RUSH ORDER FORM

2 GENERAL ELECTRONIC DISTRIBUTING CO.

DEPT. RN-10, 98 PARK PLACE, NEW YORK 7, N. Y.

MONEY BACK GUARANTEE!!



SUPERIOR'S new model 770

AN ACCURATE POCKET-SIZE VOLT-OHM MILLIAMMETER

(SENSITIVITY: 1000 OHMS PER VOLT)

FEATURES

★ Compact-measure 3⅛" x 5⅞" x 2¼".
★ Uses latest design 2% accurate 1 Mil. D'Arsonval type meter.
★ Same zero adjustment holds for both resistance ranges. It is not necessary to readjust when switching from one resistance range to another. This is an important time-saving feature never before included in a V.O.M. in this price range.
★ Housed in round-cornered, molded case.
★ Beautiful black etched panel. Depressed letters filled with permanent white, insures long-life even with constant use.

The Model 770 comes complete with self-contained batteries, test leads and all operating instructions.

SPECIFICATIONS

6 A.C. VOLTAGE RANGES: 0—15/30/150/300/1500/3000 VOLTS

6 D.C. VOLTAGE RANGES: 0—7.5/15/75/150/750/1500 VOLTS

4 D.C. CURRENT RANGES: 0—1.5/15/150 MA. 0—1.5 AMPS.

2 RESISTANCE RANGES: 0—500 OHMS 0—1 MEGOHM

$13.90 NET

SUPERIOR'S new model 670

SUPER-METER

A COMBINATION VOLT-OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5 Amperes
RESISTANCE: 0 to 500/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to .2 Mfd. .1 to 4 Mfd. (Quality test for electrolytics)
REACTANCE: 700 to 27,000 Ohms 13,000 Ohms to 3 Megohms
INDUCTANCE: 1.75 to 70 Henries 35 to 8,000 Henries
DECIBELS: −10 to +18 +10 to +38 +30 to +58

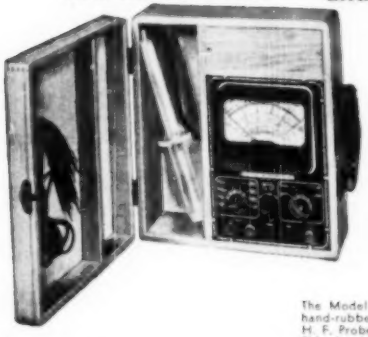
ADDED FEATURE:

The Model 670 includes a special GOOD-BAD scale for checking the quality of electrolytic condensers at a test potential of 150 Volts.

The Model 670 comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions. Size 5½" x 7½" x 3".

$28.40 NET

SUPERIOR'S new model TV-20



20,000 OHMS PER VOLT MULTI-METER and TELEVISION KILOVOLTMETER

SPECIFICATIONS

- 9 D. C. VOLTAGE RANGES: (At 20,000 ohms per Volt) 0-2.5/10/50/100/250/500/1,000/5,000/50,000 Volts
- 8 A. C. VOLTAGE RANGES: (At 1,000 ohms per Volt) 0-2.5/10/50/100/250/500/1,000/5,000 Volts
- 5 D. C. CURRENT RANGES 0-50 Microamperes 0-5/50/500 Milliamperes 0-5 Amperes
- 4 RESISTANCE RANGES: 0-2,000/20,000 ohms 0-2/20 Megohms
- 7 D. B. RANGES: (All D. B. ranges based on ODb = 1 Mv. into a 600 ohm line)
  − 4 to + 10 db + 36 to + 50 db
  + 8 to + 22 db + 42 to + 56 db
  + 22 to + 36 db + 48 to + 62 db
  + 28 to + 42 db
- 7 OUTPUT VOLTAGE RANGES: 0 to 2.5/10/50/100/250/500/1,000 Volts

ADDED FEATURE:

The Model TV-20 includes an Ultra High Frequency Voltmeter Probe, A Silicon V. H. F. Diode together with a resistance capacity network provides a frequency range up to 1,000 MEGACYCLES. When plugged into the Model TV-20, the V. H. Probe converts the unit into a Negative Peak-Reading H. F. Voltmeter which will measure gain and loss in all circuits including F. M. and T. V., check capacity and impedance, test efficiency of all oscillator circuits, measure band-width of F. M. and T. V., etc.

$39.95 NET

The Model TV-20 operates on self-contained batteries. Comes housed in beautiful hand-rubbed oak cabinet complete with portable cover. Built-in High Voltage Probe, H. F. Probe, Test Leads and all operating instructions. Measures 4½" x 10¼" x 11½". Shipping Weight 10 lbs.

TO ORDER TURN TO PAGE 98 FOR RUSH ORDER FORM

GENERAL ELECTRONIC DISTRIBUTING CO.

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3

Superior's model CA-12

SIGNAL TRACER

THE WELL KNOWN MODEL CA-12 IS THE ONLY SIGNAL TRAILER IN THE LOW PRICE RANGE INCLUDING BOTH METER AND SPEAKER!!!

SPECIFICATIONS

- ★ Comparative Intensity of the signal is read directly on the meter—quality of the signal is heard in the speaker.
- ★ Simple to Operate—only one connecting cable—no tuning controls.
- ★ Highly Sensitive—uses an improved vacuum-tube voltmeter circuit.
- ★ Tube and Resistor Capacity Network are built into the detector probe.
- ★ Built-in High Gain Amplifier—Alnico V Speaker.
- ★ Completely Portable—weighs 8 pounds—measures 5½" x 6½" x 9".

MODEL CA-12 COMES COMPLETE WITH ALL LEADS AND OPERATING INSTRUCTIONS

$29.95 NET

Superior's new model TV-30

TELEVISION SIGNAL GENERATOR

ENABLES ALIGNMENT OF TELEVISION I. F. AND FRONT ENDS WITHOUT THE USE OF AN OSCILLOSCOPE!

FEATURES Built-in modulator may be used to modulate the R. F. Frequency, also to localize the cause of trouble in the audio circuits of T. V. Receivers.

Double shielding of oscillatory circuit assures stability and reduces radiation to absolute minimum.

Provision made for external modulation by A. F. or R. F. source to provide frequency modulation.

All I. F. frequencies and 2 to 13 channel frequencies are calibrated direct in Megacycles on the Vernier dial. Markers for the Video and Audio carriers within their respective channels are also calibrated on the dial.

Linear calibrations throughout are achieved by the use of a Straight Line Frequency Variable Condenser together with a permeability trimmed coil.

Stability assured by cathode follower buffer tube and double shielding of component parts.

SPECIFICATIONS Frequency Range: 4 Bands—No switching; 18-32 Mc., 35-65 Mc., 54-98 Mc., 150-250 Mc.

Audio Modulating Frequency: 400 cycles (Sine Wave). Attenuator: 4 position, ladder type with constant impedance control for fine adjustment. Tubes Used: 6C4 as Cathode follower and modulated buffer. 6C4 as R.F. Oscillator. 6SN7 as Audio Oscillator and power rectifier.

Model TV-30 comes complete with shielded co-axial lead and all operating instructions. Measure 6" x 7" x 9". Shipping Weight 10 lbs.

$29.95 NET

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QUANTITY	MODEL	PRICE	

TOTAL

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RUSH ORDER FORM

CUT OUT AND MAIL TODAY!

4

What's New in Radio

(*Continued from page 94*)

rim-centered type of assembly which permits the cone and voice coil assembly to be replaced out in the field in the matter of minutes without the use of any special tools or jigs.

Literature on the Model 6200 and other speakers in the company's line is available on request.

CLIPPER-FILTER

A device for clipping and filtering speech before modulation in radiotelephone transmitters has been recently introduced by *Standard Transformer Corporation* of 3580 Elston Avenue, Chicago 18, Illinois.

Known as the *Stancor* SA-403-A, this compact unit is applicable to almost any existing or proposed AM or FM transmitter.

Measuring only 1¾" x 1¾" x 4⅞", the SA-403-A requires no outboard wiring and is designed to plug into

the octal socket vacated by removing a tube in the speech amplifier circuit.

Bulletin 360, giving complete specifications on the new clipper-filter, is available on request.

HYTRON TUBE PULLER

Hytron Radio & Electronics Corp. of Salem, Massachusetts, has released the seventh in its series of service technician's shop tools.

Developed after two years' research, the new tube puller is designed to permit the easy installation or removal of 7-pin miniature tubes. The positive grip insures immediate removal of the tube while the special neoprene rubber resists heat. The puller will not harm the tube and adjusts automatically to varying tube diameters. The tube puller works by suction and friction on top of the tube.

Distribution of the new tube puller is being handled by the company's jobbers.

PLASTIC-METAL SCREW

Forman Insulating Screw Corporation of 401 Broadway, New York 13, New York, has developed a new fastener which is said to be comparable in strength and accuracy to a standard metal screw yet has the additional advantages of electrical insulation, shock resistance, and vibration damping.

Basically, the new screw consists of a serrated metal core which has been extrusion-coated with a thermoplastic material. The type of core and plastic used depends entirely on the use to which the screw will be put. The metal core runs the entire length of the screw and furnishes most of the screw strength. The plastic exterior gives the unit all of its extra insulating and sealing qualities. The metal core carries the torque applied by the screwdriver.

Stock sizes range in diameter from No. 8 to ½" with cellulose acetate insulation; from No. 10 to ⅜" with polyethylene; from No. 8 to ⅜" with cellulose acetate butyrate; and from No. 8 to ½" with ethyl cellulose insulation.

Full details on stock and special items in the line are available from the company on request.

REGULATED POWER SUPPLY

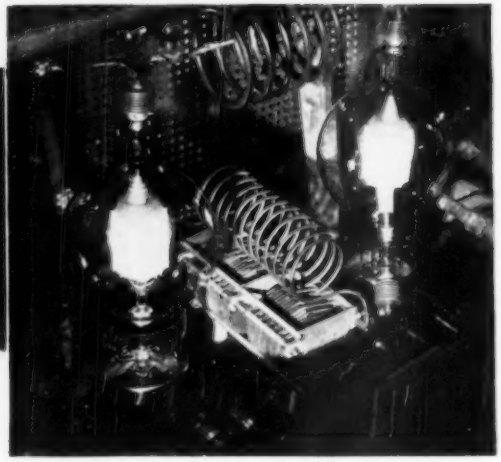
Kepco Laboratories, Inc. of 149-14 41st Avenue, Flushing, New York, has announced a new Model 510 regulated power supply which features two completely independent outputs.

Features include low ripple content, low output impedance, fuses on input and output circuits, and output cur-

(*Continued on page 149*)

STANDARDS CONTROL— Key To Quality Tube Production

Miss Norene Evans checks an Eimac 750T to determine the amount of vibration the tube elements will withstand before shorting.



Two Eimac 750TL's undergoing life testing procedure.

Unique test console provides performance data on over 50 different types of tubes.

EITEL-McCullough, Inc., makers of *Eimac* tubes, maintains the quality of its products by extensive testing of random samples of a fixed percentage of all tubes made in addition to the customary production test procedures.

The findings of the standards control department and the statistics they compile have appreciable bearing on the manufacturing techniques employed and the recommended electrical ratings for tubes. Tests performed cover all phases of the tube's electrical characteristics as well as life expectancy and their ability to withstand mechanical stresses.

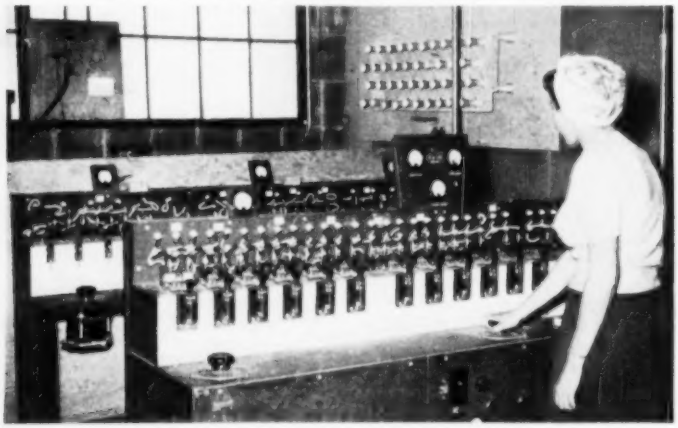
One of the instruments that this special laboratory employs is the test console shown on the front cover. It was designed and built by *Eimac* engineers to be not only versatile in the number of tube types it can test but also in the variety of tests it can perform. At present it is used to analyze over 50 *Eimac* tube types at any plate voltage up to 35 kv. As normally used, it requires from 3 to 10 minutes to complete a determination. Direct readings can be made of gas current, d.c. grid current, primary emission of the control grid, primary emission of the screen grid, mu, cathode emission, filament current, and plate, grid, and filament temperatures. Meter accuracy is checked weekly and is maintained to a 1% tolerance.

Other instruments subject tubes to tests indicating the maximum vibration they can withstand, the amount of torque the terminals will withstand, dimensional tolerances, and interelectrode capacitances.

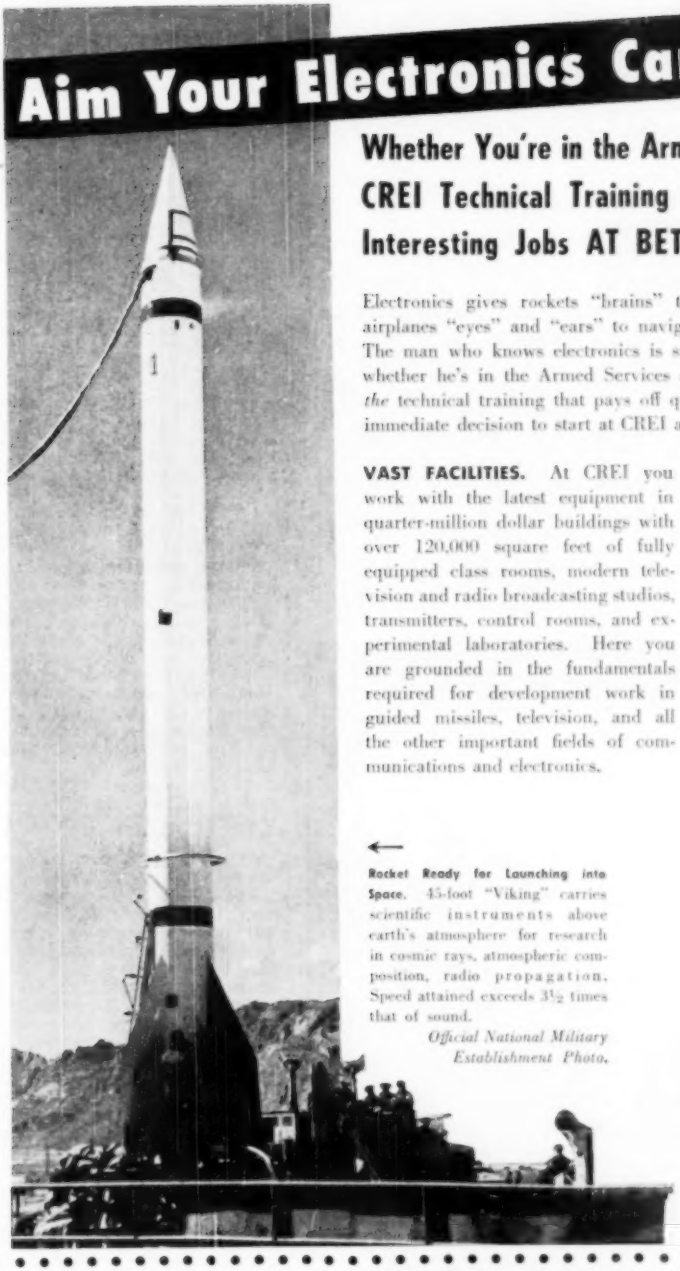
The standards control department also maintains life test racks where tubes are run to destruction under conditions simulating field use. Present accumulated data on a tube such as the 4-125A represents over a million hours of life testing and provides a wealth of needed engineering data.

—30—

Eimac 25T's undergoing life test as Miss Helen Hulshoff checks meter readings.



Aim Your Electronics Career HIGH!



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←

Rocket Ready for Launching into Space. 45-foot "Viking" carries scientific instruments above earth's atmosphere for research in cosmic rays, atmospheric composition, radio propagation. Speed attained exceeds 3½ times that of sound.

Official National Military Establishment Photo.

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Mac's Service Shop

(*Continued from page 71*)

chuck is soldered to a phone-tip jack, this jack can be slipped over the end of the test prod and so will convert it to whatever type of lead you need. These 'terminations' take up lots less space than do complete and separate test leads and serve the purpose just as well."

"Is that all we have to do?"

"Oh no; we are just getting started. I also want you to put a separate line-switch and pilot lamp on our tube checker. That present arrangement of having the line-switch on the 'Line Volts Adjust' control is not so hot. I have already had to replace two of those controls that had the wire elements worn out by the wear produced in turning the thing off and on. Putting in a separate switch will get away from this; and, while you are at it, you may as well put in a red-jeweled pilot lamp so we won't leave the tester on when we are not using it. There is plenty of room."

"And may I be so bold as to ask what *you* are going to be doing while I am slaving away on these projects?"

"You may," Mac said with a grin. "I am going to check and recalibrate our test oscillators. After those hot humid summer days, they are bound to be off a trifle; but if I correct them now, at the beginning of October, they should be all right all during the winter. I want to make sure that when our test oscillator pointer says '456 kc.' it *is* 456 kc."

"Is that so important? I don't think you would see much difference in tracking if the i.f. were off four or five kc."

"The difference in tracking is not the whole story. It *is* important that the i.f.'s be right on the nose. Broadcast stations are placed on the even ten kilocycle frequencies. The i.f. frequencies are seldom divisible by ten. This is no accident. If, by error, we should set up the i.f.'s on 450 kc., two strong broadcast stations 450 kc. apart could mix right in the input circuit and both ride on through the i.f. channel; but if our i.f. was properly set on 456 kc., this could not happen, for no two broadcast stations are ever 456 kc. apart. What is more, setting the i.f.'s off their correct frequency by only a couple of kilocycles will often put a disagreeable 'birdie' on a particular station."

"How are you going to do this recalibrating?"

"If the frequency is not too far off, I intend simply to make a correction note and paste it on the generator. For example, it may say, 'Set pointer to 454 to get 456 kc.' I prefer doing this to disturbing the insides of the instrument, and I know by experience that the oscillator may drift enough by spring so that the dial reading will again be correct. Of course, if any major discrepancy is found, I'll re-

R·H·S
SPECIALS OF THE MONTH

1000 KC crystal BT cut	$3.95
2" scope shield	1.29
2 speed dial drive for ¼" shaft ratios 5:1 1 to 1	.39
ATC 100 mmfd air trimmer screwdriver shaft	.29
—10 +5 Weston modulation meter Weston 301	8.95
J37 key	.69
500 watt 12.5 ohm power rheostat	3.49
50 mmfd 5 KV GE vacuum condenser	$1.49
2v, 6v, 12v vibrators any type	.98
Rotary switch GE Mycalex, 2 deck SP3T	.39
1 mfd 5000v oil condenser Micamold	2.98
2 mfd 3000v oil condenser Aerovox	3.25
3 mfd 4000v oil condenser Micamold	3.95
24 mfd 1500v DC 3KV flash. Excellent for speed lamp	3.95

TUBES!! BRAND NEW! STANDARD BRANDS! NO SECONDS! COMPARE! TUBES!!

OA3/VR75	$1.29
OB3/VR90	1.29
OC3/VR105	1.05
OD3/VR150	.89
1B22	2.95
1B23	8.75
1B24	4.95
1B26	2.95
1B27	24.50
1B29	2.75
1B32	1.79
1B36	24.96
1B38	32.50
1N21 Xtal	.79
1N21A Xtal	1.89
1N21B Xtal	3.25
1N22 Xtal	1.35
1N23 Xtal	1.25
1N23A Xtal	1.75
1N23B Xtal	3.95
1N27	1.69
1N34	.95
1N34A	.85
1P23	3.49
1P24	.79
1P36	2.69
1S21	3.79
2AP1	4.95
2AP5	4.95
2C21/RK33	.35
2C22/7193	.19
2C26A	.25
2C34/RK34	.39
2C39	24.50
2C40	2.75
2C43	14.95
2C44	1.49
2C46	7.50
2C51	5.75
2D21	1.25
2E22	1.19
2E24	4.69
2E26	3.69
2E30	2.29
2J21A	9.95
2J22	8.45
2J26	6.50
2J27	10.95
2J30	39.50
2J31	8.49
2J32	12.95
2J33	39.50
2J34	39.50
2J36	97.50
2J37	12.75
2J38	9.95
2J39	19.95
2J40	24.50
2J46	49.50
2J48	15.75
2J49	39.50
2J50	22.50
2J54B	22.95
2J55	89.50
2J61	49.50
2J62	49.50
2K25	19.75
2K28	24.95
2K29	24.50
3AP1	4.59
3B22/EL1C	2.39
3B23/RK22	4.85
3B24	1.95
3B24W	2.89
3B25	4.65
3B26	3.95
3B27	1.95
3B28	7.95
3BP1	2.59
3C22	59.50
3C23	6.95
3C24/24G	.89
3C31/C1B	$3.49
3C45	12.75
3CP1	1.39
3CP1-S1	2.25
3DP1	3.10
3DP1A	3.95
3DP1-S2A	4.75
3D21A	1.98
3E29	12.95
3FP7	1.65
3GP1	4.75
3HP7	2.89
4-65A	14.21
4-125A	26.95
4-250A	29.95
4AP10	4.95
4B22/EL5B	9.95
4B24/EL3C	5.95
4B25/6CF	7.50
4B26/2000	4.95
4B28	2.95
4B32	9.95
4C27/CV92	49.50
4C35	27.50
4D22	9.95
4D32	12.95
4E27/257B	17.95
5AP1	3.69
5AP4	3.69
5BP1	2.29
5BP4	2.39
5CP1	2.95
5CP7	3.49
5C22	49.55
5D21	24.50
5FP7	1.19
5GP1	4.95
5JP1	24.45
5JP2	8.95
5JP4	24.45
5J23	12.95
5J29	12.95
5J30	49.50
5LP1	11.95
5NP1	2.49
6C21	22.50
6F4	5.79
6J4	4.95
7DP7	4.49
9GP7	8.95
9JP1	5.95
9LP1	19.95
9LP7	3.49
10BP4	18.95
7DP4	17.95
10	.25
12DP7	12.25
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12HP7	12.75
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15E	1.19
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16AP4	42.50
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19T8	1.29
23D4	.45
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30 SPEC.	.39
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100R	.89
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121A	2.65
203A	5.95
204A	49.50
211	.39
212E	49.50
215A	.19
217C	$6.75
227A/5C27	2.49
249C	2.95
250R	5.95
250TH	18.95
250TL	18.95
274A	5.50
274B	1.95
276A	6.95
293A	2.98
294A	3.95
300B	9.95
304TH	3.65
304TL	2.95
305A	24.95
307A/RK75	6.95
310A	6.95
316A	.65
323A/B	24.50
327A/5C37	2.49
328A	12.95
331A	12.95
350A	2.65
350B	1.75
368AS	2.39
371A	.59
371B	.65
388A	1.75
393A	5.95
394A	3.95
417A	8.95
434A	2.95
446A	1.25
446B	1.79
450TH	39.50
450TL	44.50
527	9.75
559	1.39
562	97.50
575A	11.95
701A	2.95
702A	2.69
703A	2.39
704A	1.05
705A	.89
706BY	24.95
706CY	16.95
706FY	42.50
706GY	42.50
707B	14.95
708A	3.59
709A	3.95
710A/8011	.85
713A	.79
714AY	3.52
715A	6.49
715B	6.85
715C	24.50
717A	.69
721A	2.25
722A	2.95
723A	6.75
723A/B	12.95
724B	2.95
725A	6.45
726A	4.95
726B	29.50
726C	49.50
730A	8.95
750TL	79.50
800	1.69
801A	.25
802	4.10
803	3.10
804	9.95
805	3.49
806	29.95
807	1.98
808	1.95
809	2.25
810	9.95
811	$2.49
812	2.85
812H	6.90
813	8.95
814	2.25
815	2.25
816	1.19
826	.98
828	12.75
829	7.45
829B	12.95
830B	3.95
832	4.95
832A	7.95
833A	37.50
836A	1.25
837	1.35
838	2.35
841	.33
843	.27
845	3.75
849	29.50
851	13.95
852	6.25
860	6.95
861	10.95
864	.29
865	1.45
866A	1.15
866JR	1.15
869B	26.50
872A	1.25
874	.89
876	.35
878	1.69
884	1.49
885	1.39
902	5.95
905	2.59
908	7.95
918	1.49
919	1.95
923	.72
927	1.09
930	.89
931A	3.59
954	.29
955	.35
956	.35
957	.35
958	.35
959	.49
991/NE16	.32
1603	1.98
1613	1.25
1614	1.95
1616	.75
1619	.29
1622	1.49
1624	1.25
1625	.35
1626	.35
1629	.25
1630	.98
1631	.85
1632	.79
1633	.69
1634	.75
1636	3.25
1638	.65
1644	.98
1654	2.39
1665	1.25
1851	.89
1960	.79
1961	4.99
2050	1.25
2051	.65
8005	5.95
8011	1.75
8012	3.95
8013	2.95
8014	$24.50
8020	.89
8025	5.95
9001	.85
9002	.65
9003	.85
9004	.45
9005	2.35
9006	.29
C1JA	9.95
C5B	9.95
C6A	7.95
C6J	4.45
C100D	1.49
CK502AX	2.95
CK503AX	2.95
CK505AX	2.25
CK506AX	2.25
CK507AX	2.25
CK512AX	2.25
CK517AX	8.45
CK1005	.35
CK1006	.95
E1148	.35
EF50	.69
F123A	8.75
F127A	22.50
F128A	89.50
F606	37.60
F660	79.50
F862A	397.50
FG17	3.95
FG27A	8.75
FG32	7.95
FG57	12.95
FG81A	3.29
FG105	8.95
FG172	29.50
FG146	8.95
FG434A	2.69
FG451	.89
FG502A	1.85
GL562	97.50
GL592	14.95
HF125	14.95
HF300	19.95
HY114B	.79
HY115	.79
HY615	.29
KC4	37.50
KU610	6.95
ML101	49.50
REL21	1.95
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RK25	4.19
RK33	.24
RK34	.39
RK48A	14.95
RK59	1.49
RK65	24.50
RK72	.59
RK73	.59
RX21A	2.39
RX120	8.95
V70D	6.95
VR78	.29
VR91	1.10
VR92	.69
VT127A	3.95
VT158	14.95
VU29	2.95
VU111	.49
WL468	5.95
WL530	12.75
WL531	1.75
WL532	1.89
WL578	.89
WL616	37.50
WL619	18.95
WL677	34.50
WL681	22.50

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0B2
0Z4
01A
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1A4P
1A5GT
1A6
1A7GT
1AB5
1B3/8016
1B4
1B5/258
1B7GT
1C5GT
1C6
1C7G
1D5GP
1D7G
1D8GT
1E5GT
1E7G
1F4
1F5G
1G4GT
1G6GT
1H4G
1H5GT
1H6GT
1J6GT
1L4
1LA4
1LA6
1LB4
1LC5
1LC6
1LD5
1LE3
1LG5
1LH4
1LN5
1N5GT
1P5GT
1Q5GT
1R4
1R5
1S4
1S5
1T4
1T5GT
1U4
1V
2A3
2A4G
2A5
2A6
2A7
2B7
2V3G
2X2
2X2A
3A4
3A5
3A8
3B7/1291
3D6/1299
3LF4
3Q4
3Q5GT
3S4
3V4
5R4GY
5T4
5U4G
5V4G
5W4
5X4G
5Y3GT
5Y4G
5Z3

DUE TO THE CURRENT NATIONAL EMERGENCY AND THE CRITICAL RECEIVING TUBE SHORTAGE, TUBES WILL BE SHIPPED AT PREVAILING PRICES.

5Z4
6A3
6A4LA
6A6
6A7
6A8
6AB7
6AC5GT
6AC7
6AD7G
6AE6G
6AF6G
6AG5
6AG7
6AH6
6AJ5
6AK5
6AK6
6AL5
6AQ5
6AQ6
6AR5
6AT6
6AU6
6AV6
6B4G
6B6G
6B7
6B8G
6BA6
6BE6
6BF6
6BG6G
6BH6
6BJ6
6C4
6C5
6C6
6C8G
6D6
6D8G
6E5
6F5
6F6
6F6GT
6F7
6F8G
6G6G
6H6
6H6GT
6J5
6J5GT
6J6
6J7
6J7GT
6K5GT
6K6GT
6K7
6K8
6L5G
6L6
6L6G
6L6GA
6L7
6L7G
6N7
6Q7
6R7
6S7G
6S8GT
6SA7
6SC7
6SD7GT
6SF5
6SF5GT
6SF7
6SG7
6SH7
6SJ7
6SK7
6SL7GT

DUE TO THE CURRENT NATIONAL EMERGENCY AND THE CRITICAL RECEIVING TUBE SHORTAGE, TUBES WILL BE SHIPPED AT PREVAILING PRICES.

6SN7GT
6SQ7
6SR7GT
6SS7
6ST7
6SU7GTY
6SV7
6T7G
6T8
6U5G
6U6GT
6U7G
6V6
6V6GT
6W4
6W7G
6X4
6X5GT
6Y6G
6Y7G
6Z7G
6ZY5G
7A4/XXL
7A5
7A6
7A7
7A8
7AG7
7B4
7B5
7B6
7B7
7C4
7C5
7C6
7C7
7E5
7E6
7E7
7F7
7H7
7K7
7L7
7N7
7Q7
7R7
7S7
7V7
7W7
7X7
7Y4
7Z4
12A
12A6
12A7
12A8GT
12AH7GT
12AL5
12AT6
12AT7
12AU6
12AU7
12AV6
12BA6
12BE6
12C8
12F5GT
12H6
12J5GT
12J7GT
12K7GT
12K8
12Q7
12SA7GT
12SC7
12SF5
12SF7
12SG7
12SH7

DUE TO THE CURRENT NATIONAL EMERGENCY AND THE CRITICAL RECEIVING TUBE SHORTAGE, TUBES WILL BE SHIPPED AT PREVAILING PRICES.

12SJ7
12SK7
12SL7
12SN7
12SQ7
12SR7
12Z3
14A4
14A7
14B6
14F7
14F8
14H7
14J7
14N7
14Q7
14R7
19
24A
25L6GT
25Z5
25Z6GT
26
27
28D7
30
31
32
32L7GT
33
34
35/51
35A5
35B5
35C5
35L6GT
35W4
35Y4
35Z3
35Z4
35Z5
36
37
38
39/44
41
42
43
45
45Z3
45Z5
46
47
48
49
50A5
50B5
50C5
50L6GT
50Y6
53
56
57
58
59
70L7
71A
75
76
77
78
80
82
83
83V
84/6Z4
85
89Y
117L7/M7
117N7
117P7
117Z3
117Z6

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SELENIUM RECTIFIERS
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20F1	6.4 Amps.	4.95
20K1	13.0 Amps.	8.95
20J1	17.5 Amps.	11.95
20K2	26.0 Amps.	17.95
20K3	39.0 Amps.	24.95
20K4	52.0 Amps.	29.95
20K5	65.0 Amps.	35.95
0-40v AC	**Current**	**0-34v DC**
40D1	.6 Amps.	$ 2.95
40E1	1.2 Amps.	3.89
40F1	3.2 Amps.	5.25
40K1	6.0 Amps.	9.95
40J1	9.0 Amps.	12.95
40K2	12.0 Amps.	18.95
40J2	18.0 Amps.	22.45
40K4	24.0 Amps.	32.50
40K5	30.0 Amps.	34.95
40J4	36.0 Amps.	39.50
0-120v AC	**Current**	**0-100v DC**
40D1A	.6 Amps.	$ 7.85
40E1A	1.2 Amps.	10.76
40F1A	3.2 Amps.	16.65
40K1A	6.0 Amps.	24.75
40J1A	9.0 Amps.	32.95

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Single Phase Full Wave Bridge

10-0-10v AC	Current	0-8v DC
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10E1	2.4 Amps.	2.25
10F1	6.4 Amps.	3.87
10K1	12.0 Amps.	4.95
10J1	16.0 Amps.	7.95
10K2	24.0 Amps.	10.75
10K3	36.0 Amps.	14.75
10K4	48.0 Amps.	17.75
10K5	60.0 Amps.	19.95
10K6	72.0 Amps.	25.57
10K7	84.0 Amps.	27.95
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10K10	120.0 Amps.	42.50

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430-0-430v @ 340 MA; 6.3v CT @ 6.3A; 5v @ 6A	4.85
425-0-425v @ 75 MA; 6.3v @ 1.5A; 5v @ 3A	3.65
415-0-415v @ 60 MA; 5v CT @ 2A; 115/230 Duel Pri	4.97
405-0-405v @ 150 MA; 6.3v CT @ 2½A; 5v @ 3A; 2.5v CT @ 5A	4.35
400-315-0-100-315v @ 200 MA; 2x6.3v @ 9A; 5v @ 3A; 2.5v @ 2A	5.35
500-385-0-385v @ 200 MA; 3x6.3v @ .6A; 5v @ 3A; 2.5v @ 2A	4.75
325-0-325v @ 12 MA; 255-0-255v @ 240 MA	4.25
300-0-300v @ 65 MA; 6.3v @ 2.5A; 6.3v @ 1A; 2x5v @ 2A	3.25
80-0-80v @ 225 MA; 5v @ 2A; 5v @ 4A	2.97
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6.5v @ 12A; 6.3v @ 2A; 115v @ .1A	3.50
6.4v @ 10A; 6.3v @ .6A	2.77
6.5v @ 8A; 6.5v @ 6A; 2.5v @ 1.75A	.17
6.3v @ 1A; 2.5v @ 2A. $2.29 4-0-4v @ 1A	.87
6.3v CT @ 3.5A; 2x2.5v CT @ 3A	2.97
5v CT @ 20A; 10 KV INS	8.95
.6v @ 15A RMS	1.47

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3x6.3v CT @ 3A; 6.3v CT @ 1.6A	2.95
10v CT @ 6.5A; 6.3v CT @ 2.5A; 6.3v CT @ 1.8A 220/440 Pri.	3.95
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BC433 Receiver	Good	24.94
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BC458 Transmitter	New	8.95
BC602A Control Box/SCR522	Used	.39
BC778 Gibson Girl	Good	3.95
BC958-121 Xmitter 100-156 MC	New	39.50
BC1016 Tape Recorder	New	459.50
BC1206A Beacon Receiver	Good	4.95
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EE8 Foundation Unit	Good	4.95
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R89/ARN5 Receiver Less Tubes, Covers	Good	4.95
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15 HY @ 70 MA	1.15
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325 HY @ 2 MA	2.95
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calibrate the whole thing in accordance with the information given in the instruction manual."

"Where are you going to get your frequency standards?"

"Silly boy!" Mac chided. "I'll use the broadcast stations and WWV, of course. For the low frequencies, harmonics that fall in the broadcast band can be used. For example, I can locate 455 kc. very exactly by making the second harmonic of this frequency zero beat with the carrier of the broadcast station on 910 kc. For higher frequencies than the broadcast band, I can use fundamentals or harmonics that fall on the various WWV frequencies of 5000, 10,000, and 15,000 kc. The crystal markers we have for the i.f. frequencies of our TV generator make it unnecessary for us to worry about the calibration there.

"I also intend to check all of our meters. This afternoon I am taking the multimeter to the high school physics laboratory to set the low-range d.c. scales exactly on the nose as compared with a standard cell they have there. The a.c. ranges will also be checked against the fine a.c. meter in the lab. Then I'll bring the multimeter back to the shop and check all of our meters against it. The multimeter and another meter can be connected in parallel across a flashlight battery, a "B" battery, etc., and the two readings compared. Of course, I need not tell a seasoned old technician like yourself that both meters should be connected at the same time rather than separate readings being taken to make sure that the voltage does not change with the difference in loading between the multimeter and the other meter."

"How about the ohmmeters?"

"I'll check those by testing several wirewound resistors. Those wirewound jobs are plenty accurate enough for that purpose."

"Just supposing," Barney said cautiously, "I was able to get all of the instruments cleaned up and the tube-tester fixed before supper time. Would you have any other 'little thing' you would want me to do?"

"Oh, yes; I've got a job you will love because it is a sitting-down job. As you know, we take about every radio and television trade magazine on the market, and there is a wealth of fine, current material in these magazines that can be found nowhere else. The only trouble comes in being able to put your finger on a particular article when you want it.

"Fortunately, some of the editors appreciate this problem and do what they can to help. For example, RADIO & TELEVISION NEWS prints a complete annual index in their December issue.

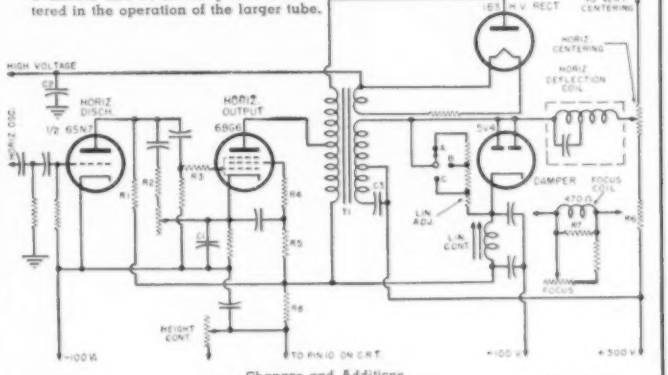
"What I want you to do is to go back through our entire file of magazines and clip out all of those indices—indexes to you—and arrange them in a loose-leaf notebook. Then when we want some information on a particular subject—say wire recorders, for example—we can look in this magazine index book and quickly sort out the issues that carried information on the subject. After that—Say, Junior, what are you looking so down-in-the-mouth about?" Mac broke off to ask.

"Well," Barney said as he got a bottle of carbon tetrachloride and a can of paste wax out of the cupboard, "I was just thinking that it will take me a full week of ordinary working days to recover from the effects of this one day that we had nothing to do!"

—30—

CONVERTING RCA 8TS30 AND 630TS TV RECEIVERS TO 16"

From Leonard J. D'Airo of Brooklyn comes details on a simple conversion for the popular models 8TS30 and 630TS to accommodate a 16" tube. The changes required are simple and easy to make. There is plenty of horizontal sweep available and no difficulty was encountered in the operation of the larger tube.



Changes and Additions

From	Change to	From	Change to
R_1 680,000 ohm	500,000 ohm	R_5 1800 ohm	3300 ohm
R_2 6800 ohm	10,000 ohm	R_6 56,000 ohm	100,000 ohm
R_3 Add	100 ohm	C_1 .1 μfd.	.25 μfd.
R_4 Add	47 ohm	C_2 .0005 μfd., 10,000 v.	.0005 μfd., 20,000 v.
R_5 22,000 + 18,000 ohm	5000 ohm	C_3 Add	.05 μfd.
R_6 Add	10 ohm	T_1 9 kv.	12.5 kv. (RCA)

Troubleshooting Chart

(*Continued from page 62*)

for all possible rigs and tubes but the fundamentals are all the same. Probably most trouble occurs with the very power-sensitive tetrode and this chart is made up with that in mind.

Even though there are only a couple of notations on the screen, don't neglect this element as it has a major influence on the tube. Usually, unless the screen is properly bypassed to the common ground point and fitted with a 50-ohm resistor to suppress parasitics it can cause all sorts of difficulties

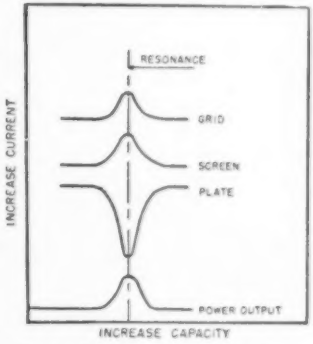


Fig. 1. Electrode current vs. loading.

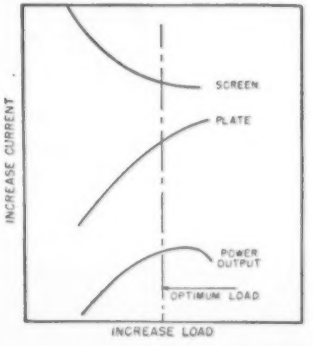
extending even to keying and modulation troubles.

The graphs are included to point out the manner in which the tube can be expected to behave under variation of load (Fig. 1) and variation of tuning (Fig. 2). It is important that anyone trying to adjust a rig for optimum performance have this information in mind.

Pay attention to the tube manual. Remember that all of the input to the screen must be dissipated as heat. Also take time to estimate the power output and compare it with the input to determine the dissipation within the tube.

—30—

Fig. 2. Electrode current vs. tuning.



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5-Digit ElecCounter 18-36V,usable 115V60 cyc w/DropResistor.... SPECIAL $2.98

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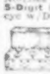

BC456 Modul, Less Tubes* & Dyn. As Is.................$1.98
BC457 Xmtr, Less Tubes*. As Is.................$3.49
BC458 Xmtr, LT*, As Is..........$3.98
BC455 Rcvr (6 to 9.1 Mc), Less Tubes* & Dyn, As Is..................$4.95

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R59/TPS3, Good, Less Tubes, As Is.39.98
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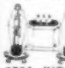

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2V 25AH G-E Portable Radio Batty Fits Ident Space. Leads Must Be Rewired...**Ea. $2.98; 2 for $5.49**
2V 27AH Willard BB54 PLUS 2 Volt Vibrator $1.98
6V/6AH Willd NT6/BB214U....... 1.69
6V/40AH Willd ER40-6............ 6.98

FL-5 FILTER

Range or Voice. Filters 1020 cycle Audio. Excellent for CW work..................89c

SOUND-POWERED Head & Chest Sets

Complete Navy Unit—Cushioned Headsets, Chest Box, Mike, Cable & Wpf Plug, Adjustable Units, Tested, Used, Exc Cond. ......**Ea. $5.49; Pair $9.98**
RCA MI-2454B Units, BRAND NEW ....**Each $7.98; Pair $13.98**
Automatic Elec Units Incl Carbon Mike ....**Each $8.98; Pair $16.98**

RM29A Control Unit

Self Contained Incl Ringer Ckt, 3 Pos Locking-type Selector—for Monitor, Direct or Radio Control, or use as Telephone,
BRAND NEW **$11.98**

HEADSETS

8000 ohms—HS18, 2 Rcvrs w/PL54 & CO73A, Less Band 98c
600 ohms—HS33, 2 Rcvrs w/Band, Cushion, Plug, Used, Exc Cond..........$1.98
250 ohms—HS30, 2 Rcvrs w/Band & Cord....................$1.69
Use HS30 as Sound Pwr Unit..2 for 2.98

LINE FILTERS

10 Amp/130vacdc Csd USN 0.1 to 1000 Mc's..........$1.29
30 Amp/250vacdc Csd USN 0.1 to 1000 Mc's $3.98; 2 $6.98
50 Amp/600vdc/250vac—Fltrs BOTH sides of Line. SOLAR "Elim-O-Stat" NEW $9.98; 2 $18; 5 $39
100 Amp/usable 110vacdc G-E. SPECIAL....................2 for $1.98

4-Year FLASHER

Indispensable for Car or Boat. Neon Bulb Flashes Brilliantly in Dark. Four Yr. Life. No Servicing. Less Battery $1.69

COAXIAL CABLE

RG8/U ....100 ft. $9.98
RG11/U ......100 ft. 10.98
TWINEX .....1000 ft. 18.75

HOOKUP WIRE SPECIALS!!

1000 ft Hookup Wire, 100 ft. asstd rolls ....ONLY $2.49
Plug & Cord Sets, 6 ft UL apprvd. ....10 for 1.50
Intercom & Spkr Wire Twisted. 500 ft. 3.49
16 ft. SJ Ext Cord Hvy Dty Male & Female Plugs .... .98
Wire #10, 1000 ft AN.......... 12.95
Wire #18, 1000 ft AN........... 4.50
CABLE Std HIV Rubber Hvy Dty.25 ft .49
"SJ"HvyDty2-cond 100ft. 2.98

TOGGLE SWITCHES

AH&H — 6 Amp/125V — UL Appvd Hi-Nickel Finish, Remvd from Equip. Bkite Csd, CLEAN, A Real Buy!
DPST 5/$1; DPDT 4/$1

MICROSWITCHES

SPNC/10A/WZ-RQ11, Plunger 69c
SPNO 10A/YZ-7RTC, Pin Plunger 54c
SPNO 10A/G-7RST1, Plunger 59c
SPNC/30A/B-1 HI-ALT, Case $1.25

ROTARY SWITCHES

Decks	Ckts	Pos	Each
1	1	2	15c
1	3	2	21c
2	2	3	41c
4	1	6	59c

TRANSFORMERS

115V 60 Cyc Inpt TV & CR Pwr Xfmr for 7" to 20" Tubes. Hi VOLTS to 20KV (w/quadrupler ckt). ALL Tubes, Pl. & Fil. wndgs diverge; 300 VDC/275Ma Full-Wave, 6.4V/10.3A, 5.4V/8A, 2.5V/3A Hypersil Core, Oil Impreg..................$8.98
1400vct 90ma, 6.3v/4a, 5v/3a H'sld $4.98
1000vct 150ma, 300v Bias, 6.3/3a, 5v/3a, 2x6.3v/.65a, 6.3v/1.25 a H'sld ...$4.50
1000vct 45ma, 795vct/80ma & 36ovct/35ma, 3x5v/3a, 6.3vct/1a, 6.3vct/.3a Csd. HiVinsul $3.98
900v 35ma, 2x2.5v/2a, H'Sld HiVins $2.98
700vct 100ma, 115v/100ma, 2x6.3v/1a, 5v/2a, Csd HiVins...............$2.98
570v 150ma, 5v/3a, 12v/4a, H'Sld HiVins $3.29
480vct 80ma, 6.3vct/4a, 5v/3a.....$1.89
420vct 120ma, 6.3v/1.9a w/inpts 6-12-24-115vdc & 115/230vac..........$1.98
360vct 340ma, 2x6.3vct/3A HiVins.$3.29
220v 50ma, 6.3v/2a, 6.3v/1a, 5v/6.3a Csd HiV insul..................$1.89

PLATE TRANSFORMERS

7500V or 15000V'Dblr/35ma......$18.95
3000v/10ma, Csd HiVinsul........ 4.50
1800v/4ma, H'Sld, HiVins......... 3.29
1200vct 300ma, 18v/1a, Csd HiVins 6.95
490 & 355vct 325ma Csd HiVins.. 4.98
2x330vct 10ma (or 660vct) H'Sld. .98

FILAMENT TRANSFORMERS

2x9V 12A ea Wndg/12.5Kv Ins...$8.98
6.3vct 4A (gnd 6.5A) H'Sld HiVins.. 1.69
6.3vct 2A ......$1.39; **6.3v/.6A** .. 1.39
2.5v/2a .... .69; **7.5vct 12A** 4.98
24v/6a csd. ..... 3.89; **24v/2a csd** 1.59

MODULATION & AUDIO XFMRS

MODUL/240Watts Peak PP Par807's to PP807's RF 2000ohmLoad STANCOR USN H'Sld $6.95
OUTPT 500Watts 3600or900 to 3oor60 ohms 2.5Kvins AMERTRAN $12.95
UNIV OUTPT 12Watts Any Tube Any Voice Coil UTAH 5909...................$1.39
LineAutoFormer/30W UTC LVM-11... 3.49
Mike or Line to Grid "ouncer" UTC O-14 50:1/200ohms to ½meg 813 List..$2.98
OUTPT 300Watts Hi-Fi PP805 to 10ohm VC, WEco H'Sld HiVins..........$12.98

FILTER CHOKES

8Hy/150ma New UTC cvrd T'Bd ....2 for $1.98
12Hy 300ma, Csd 3.95
3Hy 40ma, Csd... 3 for 1.00
50Hy 125ma, Csd 1.95
Dual12Hy/300ma.... 2/1.98
10Hy/30ma .... .59
10Hy/200ma, Csd HiVinsltd........ 1.95

BANDPASS FILTER XFORMERS

SHARP CUTOFF BiQ CASED & SHIELDED 60, 90, 150cys ..ea. **$2.25; 3 for $5.95**
UTC 854 cys, 1024 cys, 1250 cys ..ea. **$1.95; 3 for $4.50**

I-F TRANSFORMERS

456 Kc Double Slug Tuned, Shielded ...**3 for $1; 8 for $2**
10to14Mc FM&TV DoubleSlug Tuned, Shld'd **2 for $1; 5 for $2**
COLLINS USN 25Mc's Slug Tuned, 5 prong Coil...**4 for $1**
8.15to10Mc Assy Double Slug Tuned Shielded, Incl 2 SilvPlt-25mmf Ceramic Trimmers, 6 Ceramicons & 3-AB Insltd Resistors 99c

BLOWERS— Cool That Tube!

40CFM 28 vacdc **$4.98**
70CFM 115v/400cy $4.49
250CFM 28vacdc ..$9.95
250CFM & 28 to 115vac Transformer $11.95
100CFM 115vacdc 7.98
180CFM 115vacdc 10.98

TUBE SOCKETS

OCTAL, Spin&plate 9c
LOCTAL, Spin&lock Mica'B HF........10c
4-PRONG Steatite, Johnson 866.......24c
7-Pin Mini, Bot Mtg Bklte sim Amph 147-500, Ea. 13c
7-Pin Mini, Mica'B TopMtg& ½ Shield. Ea. 23c
304TL Socket $1.15

TUBES BRAND NEW Tested—Guaranteed

OA2	$1.55	6AB5/6N5	$1.33	6S4	$1.16	12AH7GT	$1.33	35C5	$1.00
OA3/VR75	1.33	6AB7/1853	1.60	6S8GT	1.41	12AL5	1.00	35L6GT	.83
OA4G	1.33	6AC7	2.03	6SA7GT	.83	12AT6	.79	35W4	.65
OB2	1.78	6AD5	1.19	6SB7Y	1.20	12AT7	2.03	35Y4	.90
OB3/VR90	1.33	6AD7	1.60	6SC7	1.00	12AU6	1.04	35Z3	.90
OC3/VR105	.98	6AF5	.89	6SD7GT	1.45	12AU7	1.68	35Z5GT	.63
OD3/VR150	1.33	6AF6G	1.33	6SF5	.83	12AV6	.79	REL36/6J4	.54
OZ4	.83	6AG5	1.41	6SF7	1.00	12AV7	1.89	50L6GT	.87
1A3	1.10	6AG7	1.71	6SG7	1.04	12AW6	1.47	VR92	.25
1A5GT	.90	6AH6	2.73	6SH7	1.17	12AX7	1.68	807	2.39
1A7GT	1.00	6AJ5	2.29	6SJ7GT	.87	12BA6	1.26	829	6.48
1B3/8016	1.86	6AK5	2.73	6SK7GT	.87	12BA7	1.20	832	7.98
1C5	1.10	6AK6	1.68	6SL7GT	1.28	12BD6	1.00	866A	.98
1D8GT	1.95	6AL5	1.40	6SN7GT	1.54	12BE6	1.26	866Jr	1.04
1G4GT	1.33	6AL7	1.33	6SN7WGT	2.09	12BF6	.83	872A	1.29
1G6GT	1.33	6AN5	4.20	6SQ7GT	.79	12BH7	1.28	C'RAY TUBES	
1H5G	1.33	6AQ5	1.40	6SR7	.95	12C8	1.60	2AP1	3.55
1J5G	1.20	6AQ6	.90	6SR7GT	.95	12E5	.98	2AP5	7.98
1L4	1.00	6AQ7GT	1.28	6SS7	.90	12F5	.90	3AP1	4.69
1LA4GT	1.33	6AR5	1.33	6SU7GTY	3.37	12H6	.95	3BP1	2.39
1LA6	1.33	6AR6	4.58	6SV7	1.45	12J5GT	.75	3BP1A	7.98
1LB4	1.33	6AS5	1.06	6T8	2.03	12J7GT	1.00	3CP1-S1	2.49
1LC5	1.33	6AS7G	4.49	6U4GT	1.41	12K7GT	.83	3DP1	3.75
1LD5	1.33	6AT6	.79	6U5/6G5	1.00	12K8	1.20	3DP1-S2	4.65
1LE3GT	1.33	6AU5GT	1.41	6U6GT	1.06	12L8GT	1.59	3EP1	2.45
1LH4	1.33	6AU6	1.40	6V6GT	1.06	12Q7GT	.90	3FP7	1.69
1LN5	1.33	6AV6	1.05	6V6M	1.71	12S8GT	.90	3GP1	4.89
1N5GT	1.00	6AW6	1.41	6W4GT	.95	12SA7GT	.83	3HP7	4.80
1P5GT	1.33	6AX5GT	.69	6W5GT	.75	12SC7	1.10	3HP14	9.98
1R4/1294	1.33	6B4G	1.60	6X4	.79	12SF7GT	1.00	3JP1	19.50
1R5	1.00	6B8G	1.60	6X5GT	.79	12SG7	1.00	3JP12	19.95
1S4	1.20	6BA4	1.08	6Y6G	1.28	12SH7	1.10	4AP10	4.70
1T4	1.00	6BA6	.95	6ZY5G	1.10	12SJ7GT	.83	5AP1	3.75
1T5GT	1.33	6BA7	1.20	7A4/XXL	1.00	12SK7GT	.83	5BP1	2.25
1U4/5910	1.00	6BC5	1.06	7A5	1.10	12SK7M	.86	5BP4	4.50
1U5	.90	6BD6	1.06	7A6	.90	12SL7GT	1.20	5CP1	1.75
1V	1.10	6BE6	1.26	7A7	.90	12SN7GT	1.17	5CP7	3.70
1V2	.97	6BF6	.83	7A8	.90	12SQ7GT	.79	5FP7	1.26
1X2	1.86	6BG6G	3.36	7AD7	1.41	12SR7	1.10	5FP14	18.98
1Z2	3.98	6BH6	1.06	7AF7	.90	12X3	.90	5GP1	6.95
2A3	1.60	6BJ6	1.06	7AG7	1.10	12Z3	1.33	5HP1	4.95
2A4G	2.40	6BQ6GT	1.71	7AH7	1.10	14A4	1.33	5HP4	6.75
2B4	1.33	6C4	1.16	7B4	.95	14A7/12B7	1.10	5JP1	39.95
2B22/GL559	.73	6C5	.83	7B5	.95	14AF7	1.26	5JP2	11.75
2C21/1642	.81	6C6	1.00	7B6	.95	14B6	1.10	5LP1	11.89
2C22/7193	.15	6C8G	1.60	7B7	.90	14B8	1.10	5MP1	4.75
2C26	.15	6CB6	1.40	7B8	.90	14C5	1.33	5NP1	3.98
2C34/RK34	.21	6CD6G	3.49	7C4/1203A	.33	14C7	1.20	7BP7	4.65
2D21	1.80	6D4	2.75	7C5	.95	14E6	1.10	7CP1	12.95
2G5	.98	6E5	1.10	7C6	.95	14E7	1.33	7JP4	16.49
2V3G	.49	6F5	.83	7C7	.90	14F7	1.10	9GP7	8.89
2W3GT	.98	6F6	1.06	7E5/1201	1.33	14F8	1.33	9LP7	10.98
2X2	.36	6F6GT	.87	7E6	1.10	14H7	1.20	10BP4	19.49
2X2A	1.92	6F8	1.60	7E7	1.33	14J7	1.33	10FP4	24.50
3A4	.32	6G6	1.33	7F7	1.10	14N7	1.33	12DP7	12.45
3A5	.75	6H6	.87	7F8	1.41	14Q7	1.10	12GP1	49.98
3B4	3.49	6J4	4.41	7G7/1232	1.33	14R7	1.33	12GP7	12.70
3B5	.98	6J5	.79	7H7	1.06	14S7	1.33	12JP4	27.00
3B7/1291	.29	6J5GT	.78	7J7	1.33	14W7	1.33	12KP4	34.00
3D6/1299	.29	6J6	2.03	7K7	1.33	14X7	1.33	12LP4	24.35
3D21A	.95	6J7GT	1.00	7L7	1.33	14Y4	1.20	12QP4	32.00
3LF4	1.33	6K5GT	1.28	7N7	1.17	19BG6G	3.22	12RP4	36.00
3Q4	1.10	6K6GT	.79	7Q7	.90	19J6	1.71	15DP4	56.00
3Q5GT	1.20	6K7	.83	7R7	1.10	19T8	1.55	16AP4	49.00
3S4	1.00	6K8	1.20	7S7	1.33	24G/3C24	.69	16DP4	49.98
3V4	1.00	6L6	1.90	7T7	1.03	25AC5GT	1.95	16FP4	57.50
5R4GY	1.26	6L6GA	1.55	7V7	1.33	25BQ6GT	1.60	16RP4	49.98
5T4	1.95	6L7	1.28	7W7	1.41	25L6GT	.87	16TP4	49.98
5U4G	1.05	6N4	1.08	7X7/XXFM	1.33	25W4GT	1.40	19AP4	96.00
5V4G	1.25	6N6G	1.95	7Y4	.90	25Z5	.75	19CP4	85.00
5Y3GT	1.28	6N7GT	1.28	7Z4	.95	28D7	.28	902	3.15
5Z3	.90	6P5G	1.20	10Y	.29	32L7GT	1.60	905	2.45
5Z4	1.33	6R7	1.33	12A6	1.28	35A5	.90	910/3AP1	4.63
6AB4	1.06	6R8	.79	12A8GT	1.00	35B5	1.06	912	89.98
								914	45.00

WRITE FOR QUANTITY PRICES

THAT'S A BUY "TAB" THAT'S A BUY

DEPT. 10RN SIX CHURCH ST. NEW YORK 6, N.Y., U.S.A. - CORNER CHURCH & LIBERTY STS. ROOM 200

Write for Your FREE "TABOGRAM"

$3Min Order FOB NYC. Add Shpg Charges&25%Dep. Shipments Gtd R'Exp. Only. Prices Subject to Change Without Notice.

Phone: WOrth 2-7230

THE AD-VISER

2 SUCCESSFUL LAYOUT TECHNIQUES

By
IRVING SETTEL

WHEN a man builds a house, there must be some written plan to guide the constructor. Advertisements, like houses, must have a blueprint from which advertising people can work. The layout, however crude, is a pictorial representation which depicts the idea of the proposed advertisement.

The importance of a well constructed layout cannot be overemphasized. This does not mean that high priced artists must be employed. As a matter of fact, anyone can create an effective layout if he knows the basic formula. Thousands of radio and television dealers insist upon personally executing this vital task. Having learned the "tricks of the trade," they feel that layout making is important enough to warrant their personal consideration. They feel too that this should not be entrusted to others when it takes so little time and is so easy to accomplish.

Why a Layout Is Important

First, let us discuss why a layout plays such an important role in advertising. As part of the advertisement, an effective layout can mean the difference between getting your message read and having it ignored in favor of your competitors' ads. Competition is so keen in modern newspapers that the element of attention-getting is of utmost importance. Your layout, if it is a good one, will *attract attention*. In addition, it will maintain the readers' attention long enough to get your message across. Layout should guide the potential customer's eye from the starting point, usually the headline or illustration, through the structural sequence of the written message. It will keep the reader's eye within the framework of your ad. It will move the eye from one logical resting place to another . . . from the *headline* to the *message* to the *price* to your *store name*.

It is urged that every radio and television dealer at least assist in making his own layouts. If you have an advertising agency handling your account, do not hesitate to submit rough suggestions. If your local newspaper makes up your ads, your help will be appreciated. The newspaper advertising department is usually too busy to give you individual consideration so necessary to effective layout and selling. In addition, chances are that they are making up your competitors' ads too. This means that each advertisement will probably look alike to the average reader. Drawing your own layout will add distinctiveness to your promotion. Your interest will result in better layouts and consequently, more profitable trade. No one knows your business or customers as well as you do. No one knows better how to combat competition than the dealer who must contend with competitive situations every day.

Expensive equipment is not necessary for layout work. A five and dime store smooth paper pad is sufficient. The size will depend upon the largest ad you intend to run. In addition, purchase a few very soft pencils, a ruler, a triangle and a soap eraser. Your complete cost should not exceed $2.50.

Effective Layout

There are three basic elements which are included in most ads. They are as follows:

1. The *illustration*. . . . Not always used but highly recommended for all radio and television ads.

2. The *copy*. . . . Includes the headline, subheadline, paragraphs of copy, prices, sizes, etc.

3. The *logotype*. . . . The name of your store or organization, always necessary in *every* ad.

Before making the layout, you should decide approximately what the headline will be. You should have an idea which items you intend to display as illustrations. You should know how much space the copy will consume. It is your job to determine the best placement of these elements. Never forget that you are primarily interested in attracting attention, maintaining attention, and directing the reader's eye into the proper channels. First make a series of miniature tryouts or *thumbnail sketches*. Draw a few small boxes which have been scaled down from the proposed newspaper size.

Roughly sketch in your headline. A scribbled mass for the illustration is sufficient. Draw horizontal lines for copy. After your first thumbnail sketch is completed, try another. Draw the elements in different places. Slant your headline, place a border around your copy, make the entire advertisement in reverse (white on

black). After making a few of these, choose the sketch which you believe best fulfills the essentials of good promotion. Then roughly draw this in correct size. As rough as it is, if you are careful in its execution, it is probably good enough a layout from which a newspaper can work.

We know that our layout must attract attention. This means that it must be different from other ads. There are many tricks which can be employed to achieve *difference* and some of the better ones are the following:

Balance . . . Place your layout elements in unusual positions, still maintaining the structure necessary to good balance. Sometimes, extremes are useful but often a little slant of your headline, illustration and copy will do the trick.

Border . . . A border surrounding the ad will not only create unity but also achieve distinction. Unusual borders have been used successfully to attract attention.

Backgrounds . . . Unusual backgrounds look good but are dangerous. They may attract attention to themselves, thereby taking away interest from the sales message of the ad. Use backgrounds sparingly.

White Space . . . The use of white space is probably one of the most effective methods of achieving attention. The more white space surrounding the ad, the less competition from the other ads. Although some radio and television merchants frown upon the buying of space for this purpose, white space has probably sold more radios and television sets indirectly than any other element of layout.

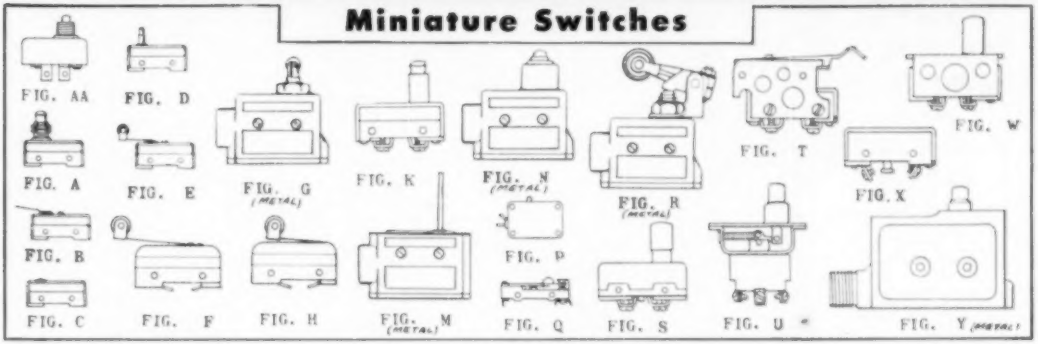
Movement . . . Arrows, pointing hands, etc., all assist in moving the reader's attention from one place to another. More popularly used in pointing illustrations. For example, some advertisers illustrate their wares pointing toward the next structural step in the ad. This causes the reader to look in the same direction. Properly placed illustrations will do a fine job of leading the eye. When the principle of movement has been effectively applied, the eye is led from one feature of the ad to another in the order of importance.

Reverse . . . When your competitor is using great portions of white space, you can achieve interest and distinction by using reverse or white headlines, copy and illustration on a black background. Your "black ad" will be different and thereby attract attention in contrast to the "white ads."

Ovals and circles . . . The shape of the advertisement as determined by a newspaper, is either square or rectangular. However, the shape of the ad itself need not conform to this contour. Ovals and circles are very effective attention getters because of the contrast they present to the straight lines of the average ad. You can also set up your headline in various shapes and have a round illustration made. Sometimes the reading

SAVE on Miniature and Toggle Switches at WELLS

Miniature Switches



STOCK NUMBER	MANUFACTURER	MFR. TYPE NO.	CONTACTS	ILLUSTRATION	PRICE EACH
305-10	Microswitch	WP3M5	N.C.	FIG. AA	$0.40
305-160	Microswitch	WP-5M3	N.C.	FIG. AA	.40
307-210	Microswitch	YP3A	N.O.	FIG. AA	.50
303-67	Microswitch	YZ7RA6	N.O.	FIG. A	.71
PH-100	Acro	RO162T	N.O.	FIG. A	.75
301-46	MU-Switch	MLB-321	SPDT	FIG. B	.85
301-93	Microswitch	YZ-2YLTC1	SPDT	FIG. B	1.01
301-30	MU-Switch	RO2M	SPDT	FIG. B	.95
301-78	MU-Switch	Green Dot	SPDT	FIG. B	.75
303-79	Microswitch	BZ-RL32	SPDT	FIG. B	.75
303-65	MU-Switch	ML8329	SPDT	FIG. B	.67
305-154	Acro	XD4-5L	SPDT	FIG. B	.78
312-130	Acro		SPDT	FIG. B	.70
PH-101	Microswitch	BRL16	SPDT	FIG. B	.78
PH-102	Microswitch	YZRL8T2	N.O.	FIG. B	.65
PH-104	Microswitch	YZ3RLTC2	N.O.	FIG. B.	.64
PH-105	Microswitch	YZR31	N.O.	FIG. C	.53
PH-106	Microswitch	R-R36	N.C.	FIG. C	.50
PH-107	Microswitch	BR-26	N.C.	FIG. C	.53
PH-108	Microswitch	WZ-2RT	N.C.	FIG. C	.50
305-161	Microswitch	YZ3R3	N.O.	FIG. C	.71
311-115	Microswitch	WZR31	N.C.	FIG. C	.71
311-123	Microswitch	WZ-7R	N.C.	FIG. C	.60
311-126	Acro	HRRC7-1A	N.C.	FIG. C	.50
311-125	Acro	HRRO7-1A	N.O.	FIG. C	.53
311-121	Microswitch	WZ7RTC	N.C.	FIG. C	.50
311-126B	Microswitch	YZ	N.O.	FIG. C	.53
370-6	Microswitch	X757	N.C.	FIG. C	.45
PH-119	Microswitch	WZR-8X	N.C.	FIG. C	.45
PH-109	Microswitch	BRS13	N.C.	FIG. D	.45
PH-110	Microswitch	BRS36	SPDT	FIG. D	.53
PH-111	Microswitch	GRS	N.O.	FIG. D	$0.45
311-116	Microswitch	SW-166	N.C.	FIG. D	.63
303-49	Microswitch	YZ2YST	SPDT	FIG. D	.68
309-93	Microswitch	BRS36	SPDT	FIG. D	.66
370-17	MU-Switch	QRS	SPDT	FIG. D	.75
PH-112	MU-Switch	MBW	SPDT	FIG. E	.72
311-25	MU-Switch	CUN24155	N.C.	FIG. E	.65
370-10	Acro	RO2M12T	N.O.	FIG. E	.70
303-32	Microswitch	YZ-3RW2T	N.O.	FIG. F	.65
306-10	Microswitch	BZE-2RQ9TM1	SPDT	FIG. G	2.46
PH-120	Microswitch	YZ7RQ9T6	N.O.	FIG. G	.75
309-101	Microswitch	BZ-2RW221	SPDT	FIG. H	.95
PH-113	Microswitch	RZBQT	SPDT	FIG. K	.58
L306-1010	Acro	RO7-6586	N.O.	FIG. K	.55
370-18	Acro	HRO71P2TSF1	N.O.	FIG. K	.60
370-19	Microswitch	YZRQ41	N.O.	FIG. K	.65
370-8	Microswitch	RN-11-H03	SPDT	FIG. M	1.50
309-157	MU-Switch	——	N.C.	FIG. N	1.15
370-15	MU-Switch	AHB203	SPDT	FIG. N	1.25
370-7	Microswitch	WZE-7RQTN	N.C.	FIG. N	1.35
305-11	Acro	2M031A	N.O.	FIG. P	.37
305-50	Microswitch	Open Type	SPDT	FIG. Q	.35
303-64	Acro	HRQ7-4PST	N.O.	FIG. S	.50
303-63	Microswitch	YZ-RQ4	N.O.	FIG. S	.50
PH-114	Microswitch	WZR-31	N.C.	FIG. T	.65
PH-115	Cutler-Hammer	8905K564	DPDT	FIG. U	.65
PH-116	Microswitch	WZRQ41	N.O.	FIG. W	.60
PH-118	Microswitch	BZRQ41	SPDT	FIG. W	.60
311-126A	Microswitch	YZ-RTX1	N.O.	FIG. X	.90
PH-117	MU-Switch	Z	N.C.	FIG. Y	1.35

Toggle and Push Switches

STOCK NUMBER	FIG.	CONTACT ARRANGEMENT	MANUFACTURER & NUMBER	PRICE EACH
PH-500	A	SPDT	B1B	$0.35
PH-501	A	SPDT	AN3022-3B	.35
PH-503	A	SPDT CENTER OFF MOM EACH SIDE	611	.32
PH-505A	A	SPDT MOMENTARY	621	.30
PH-505	A	SPST	AN-3022-2B	.30
PH-506	A	SPDT CENTER OFF	AN-3022-1	.35
PH-507	A	SPDT CENTER OFF MOM EACH SIDE	AN-3022-7B	.32
PH-508	A	SPST MOMENTARY	AN-3022-8	.28
PH-513	A	SPDT CENTER OFF	CH AN-3022-1B	.36
PH-514	A	SPST	CH B-5-A	.35
PH-516	A	SPST	B5	.35
LT-104	A	SPDT 1 SIDE MOMENTARY	CH 8905K568	.35
309-168	A	SPST	168551	.30
370-1	A	SPST MOMENTARY	CH AN-3022-6B	.25
370-4	A	SPDT CENTER OFF	CH B-9A	.35
370-14	A	SPDT CENTER OFF 1 SIDE MOM.	CH B-7A	.30
370-25	A	SPST MOMENTARY	CH B-6B	.25
305-171	A	SPDT CENTER OFF MOM 1 SIDE	020840	.32
309-169	B	SPST MOMENTARY	CH B-1B	.35
PH-509	C	DPST	AN-3023-2B	.45
PH-510	C	DPDT MOMENTARY	CH 8715K2	.50
PH-511	C	DPDT MOMENTARY	CH 8715K3	.50
PH-512	C	DPST CENTER OFF	CH 8720K1	.55
PH-515	C	DPDT CENTER OFF	C-9A-8700K2	.55
PH-517	C	DPDT	C-9A-8701K2	.55
303-65	C	DPST	CH AN-3023-2	$0.45
305-174	C	DPDT CENTER OFF MOM 1 SIDE	AN-3023-5	.50
305-177	C	DPDT CENTER OFF MOM EACH SIDE	C-3	.50
305-176	C	DPDT CENTER OFF MOM EACH SIDE	AN-3023-7	.50
305-173	C	DPDT	8710K1	.55
305-175	C	DPDT CENTER OFF MOM EACH SIDE	3717K1	.50
305-179	C	DPDT CENTER OFF MOM EACH SIDE	8732-K2	.50
309-163	C	DPDT CENTER OFF MOMENTARY	CH C-11	.55
309-162	C	DPST	CH C-1	.45
309-164	C	DPST MOMENTARY	CH 8711K3	.40
370-31	C	DPDT	CH C-1B	.55
305-87	D	1 SIDE DPST MOM 1 SIDE SPST	AH & H	.55
LT-100	F	SPST	CH	.22
LT-101	F	SPST MOMENTARY	AH & H w LEADS	.20
301-51	G	4PDT MOMENTARY	CH 8905K12	.75
305-140	H	DT NO MAKE EACH SIDE	OPEN FRAME	.25
309-161	K	SPST	CH 8761K3	1.35
305-76	L	DPST	AH & H OPEN FRAME	.75
301-17	M	DPST	AH & H SPECIAL FOR HANDY	.40
LT-107	N	DPST	AH & H TALKIE	.25

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matter can be set in unusual shapes. This is often difficult to read and should be avoided.

The above "tricks" when applied carefully, easily solve the problem of attracting attention. Before deciding upon any or all of these, study your newspaper and your competitors' ads. Try to achieve *difference* and you will be achieving *interest*. Utilize all the production facilities of your newspaper. Use the *benday* or dotted background for interesting design. Use large bold headlines for blatant attention. However, always be on your guard lest in gaining attention of the reader, the element of attraction detracts from the sales message. Never forget that *selling* is the main purpose of the ad.

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PHASE SHIFT OSCILLATOR

By RUFUS P. TURNER, K6AI

MANY textbooks make passing mention of the phase shift RC oscillator circuit. Advantages of this oscillator are: good waveform and stability; elimination of transformers, chokes, and other coils; simplicity; and compactness. It is a logical choice for single-frequency work, such as the modulating oscillator in a signal generator. However, few published works go so far as to give actual practical circuit constants for this oscillator circuit.

The accompanying diagram shows the complete circuit of a 400-cycle phase shift oscillator worked out by the author. In this arrangement, one half of a 12AT7 miniature twin triode tube is used as the phase shift oscillator, the other half as an isolating amplifier. The oscillation frequency is determined by the 3-condenser, 3-resistor phase network: C_3, C_5, C_7, R_1, R_2, and R_3. The six components in this group must, therefore, be measured carefully for exact specified values.

Audio output is approximately 25 volts into open circuit. Some improvement in stability can be expected by employing a 250-volt regulated d.c. power supply.

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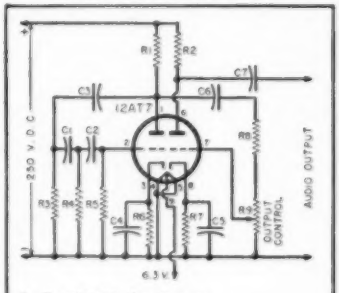
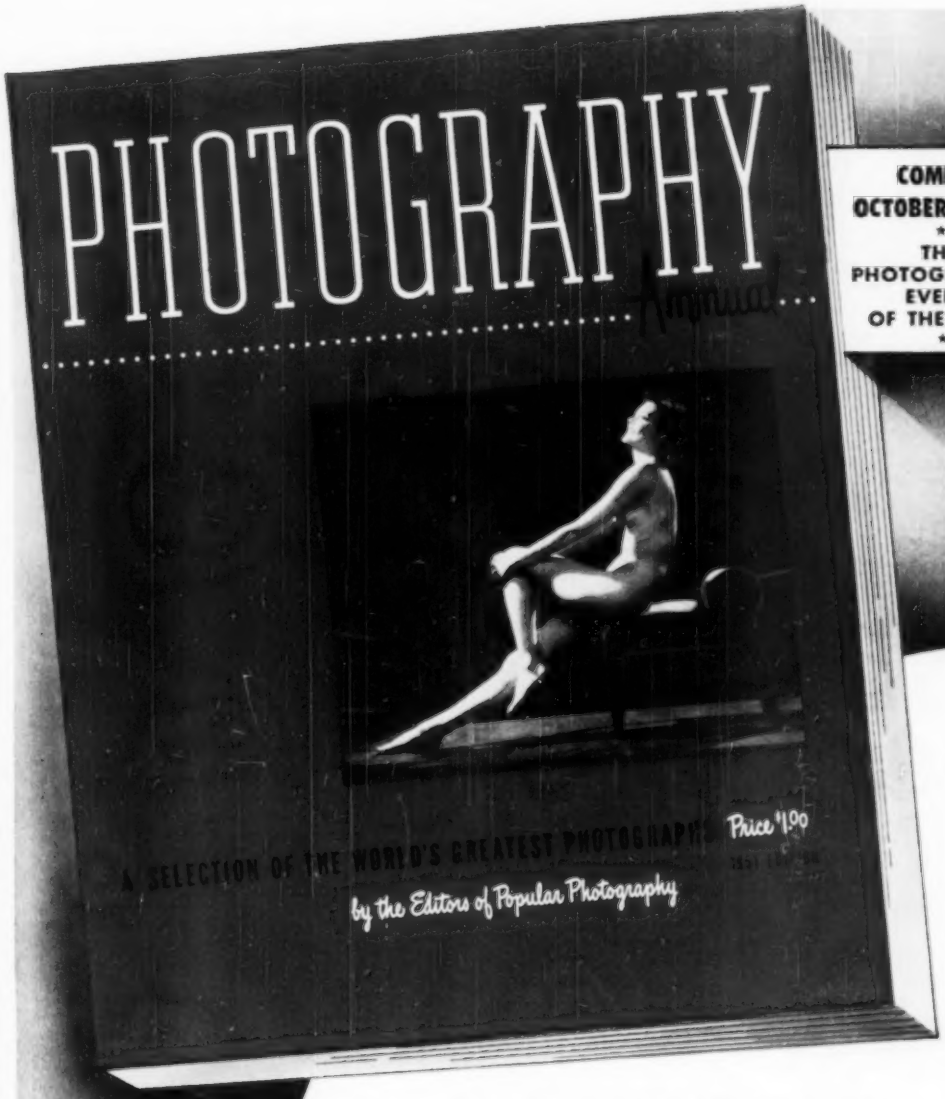
Diagram of phase shift oscillator.



R_1, R_2—50,000 ohm, 1 w. res.
R_3, R_4, R_5—75,000 ohm, ½ w. res.
R_6—500 ohm, 1 w. res.
R_7—2500 ohm, 1 w. res.
R_8—5 megohm, 1 w. res.
R_9—1 megohm pot.
C_1, C_2, C_4—.002 μfd. mica or ceramic cond.
C_3, C_5—16 μfd., 25 v. elec. cond.
C_6, C_7—.1 μfd., 400 v. cond.
1—12AT7 tube



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(Continued from page 47)

that the output capacity of the reproducing system must be quadrupled in order to produce the same approximate sound level. This, of course, may be of considerable economic importance where large amounts of power are being handled, such as in broadcast work or public address. For the high fidelity enthusiast, not only must the implications of added power reserve be considered but also the effect of the heightened transient and complex wave response upon his amplifier and speaker system.

Thus, the choice of a microphone appears to depend, to a large extent, upon the associated equipment as well as the type of mike pickup to be used, but, in any event, the user should be well aware of the difference between the peak and average output of the microphone. The most accurate indicator of peak recording level will be an oscilloscope or a peak reading vacuum tube voltmeter. If the conventional r.m.s. voltmeter is used as a volume level indicator, it is safest to calibrate the peak meter swing against an oscilloscope while talking into the microphone. Usually the meter will read from six to twenty decibels below the peak level indicated by the scope screen, depending upon the type of microphone, meter damping, and the strength of the voice transients.

Microphone placement is another problem in good reproduction. It is sometimes assumed that a closeup microphone technique is desirable because it minimizes the effects of the acoustics in the recording environment and allows control of the balance between the various instruments or voices through multiple microphone mixing. There are several drawbacks to this method, however, particularly in monaural reproduction. One of the most important of these is the fact that the tone color of many instruments is strongly affected by surrounding acoustics, especially in the case of instruments which produce strong transients which are converted to relatively slowly damped wave trains by a room with "live" acoustics. Obviously it will be much easier for the average reproducing system to handle these fairly long damped wave trains than to handle the brief, powerful, initial transient. Likewise, since the average living room does not have concert hall characteristics a fairly distant pickup may be desirable from the standpoint of added "liveness." Another interesting example of close vs distant pickup has to do with the human voice. An examination of oscilloscope patterns shows that the voice may produce strong transients with a repetition rate of between 100 and 200 cycles. These transients may stimulate chest cavity or room resonances strongly

giving a resultant "deep" voice to the individual. However if the microphone is held close to the lips, radiation from the chest and other sources will be discriminated against with resultant unnatural reproduction, although low frequency resonances in the reproducing system may be excited to produce the well-known "boomy" speech.

If distant pickup microphone technique is desired, such as currently seems to be gaining favor, it is important that nonlinearity in the microphone and recorder be reduced to a minimum. This is because of the fact that if the microphone is separated from the sound source by more than a few feet, most of the energy it receives will result from wall reflections. If the system is nonlinear, high amplitude sounds will usually suppress weaker tones and a careful balance between the pickup of direct and reflected sound radiation must be achieved for passable results. In the case of a linear system the microphone may be placed with the assurance that the output will simulate that which a live auditor would hear at that location, subject to the limitations of monaural reproduction. Other than the microphone, the most likely sources of nonlinearity are due to improper tape bias adjustment and in the loudspeaker of the playback system. A method used by the author for adjustment and testing of equipment is to place the microphone in the center of a conventional "live" room and record a number of various sounds simultaneously, such as a wrist watch ticking nearby, a larger clock across the room, someone talking quietly at the end of the room, and traffic in the street. With poor equipment the result will be a confused jumble of noise, while with good linearity the result will be remarkable clarity and ability to separate and recognize the various sounds.

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ANTENNA AD STANDARDS

IN an attempt to eliminate abuses in the advertising of television antennas, The Antenna Section of the Radio-Television Manufacturers Association has set up a sub-committee to formulate advertising standards which will be released in conjunction with the section's antenna engineering standards.

Heading the new sub-committee is Douglas Carpenter, Sales Engineer of LaPointe Plascomold Corp. of Unionville, Conn. Serving with Mr. Carpenter are: Larry Kline of Ward Products Corporation, and Carl V. Wisner of American Phenolic Corporation. The committee's job is two-fold—first, to undertake plans for a publicity campaign to advertise the fact that member's products, in their advertising, will be RTMA approved, and second, to develop an approval seal which would quickly identify all such advertising and which could also be applied to the products themselves.

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Manufacturers' Literature

Readers are asked to write directly to the manufacturer for the literature. By mentioning RADIO & TELEVISION NEWS, the issue and page, and enclosing the proper amount, when indicated, delay will be prevented.

CD CATALOGUE

Cornell-Dubilier's new Catalogue No. 410 covering its line of "Powercon" vibrator converters is a combination catalogue and manual that can also serve as a handy reference and guide.

Twenty-two models in five different types are covered, *i.e.*, a.c. and d.c. converters, phono motor and record player converters, battery chargers and eliminators, d.c. to a.c. converters, and d.c. and a.c. mobile and fixed station dual-operation converters. Each model is illustrated and described in detail. In addition, there is a 9-page manual on using vibrator converters.

Copies of the new Catalogue No. 410 may be obtained from the company at South Plainfield, New Jersey.

UTC CATALOGUE

The complete *UTC* line of transformers, reactors, and filters is listed and described in the new Catalogue 500 issued by *United Transformer Company*, 150 Varick Street, New York 13, New York.

This 28-page catalogue carries concise descriptions on all of the units, application data, amplifier circuits, performance curves, and other useful information in tabular form.

Copies of this new publication are available without charge from the company.

"TRIPLE PINDEX"

A new and revised edition of *RCA's* "Triple Pindex," the handy quick-reference guide to tube base diagrams, has been announced by the company's Tube Department.

Enlarged throughout, the base diagrams for more than 600 tube types, including more than 60 kinescopes, have been included in this new edition. The guide permits instant location and simultaneous study of any two or three base diagrams. The "Triple Pindex" is actually three complete and separate base diagram booklets which are joined in a single cover by a spiral wire binding. To locate a tube base diagram, the technician flips over the pages of one of the booklets. If a second diagram is needed, it may be located in the second booklet without disturbing the first diagram. A third

Television and radio sets are repaired at the customers' doors with equipment and tools carried in this unusual truck, owned by Electro-Crafts Television of Kansas City, Missouri. This fully-equipped laboratory-on-wheels was built into a standard Dodge truck. An auxiliary generator provides 110 volts a.c. to operate equipment.

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20-20	150	20-10	175
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CT-625	360VCT	.340	6.3VCT-3A, 6.3VCT-3A	3.95
CT-076	600V	.100	2 x 12.6V-1	3.95
CT-626	1500V	.200	2.5-12, 30 / 100	3.95
CT-15A	350VCT	.070	6.3 / 6, 6.3-1.5 3 Dis.	2.95
CT-071	110V	200	33 / 200, 5V-10, 2.5-10	4.95
CT-178	2300V	4 MA	2.5/2	4.95
CT-367	580VCT	.050	5VCT-3A	2.25
CT-721	550VCT	.100	6.3/1, 2.5VCT-2	2.95
CT-99A	2x110VCT	.100	6.3/1A, 2.5VCT-7A	3.25
CT-91A	720V	.100	5V-3A, 6.3-3.5	3.25
CT-080	700VCT	.205	5V-3, 5V-2A	3.95
CT-328	115V	2.2	40V-2.2A, 115V-2.2A	4.49
CT-441	50V	2.00	5V-2.4, 5V-1.2	2.75
CT-408	350VCT	.025 MA	5V-3A	2.75
CT-26B	2100VCT	.400 MA	6.3V-1.6	6.95
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CT-610	1250	.062 MA	2.5V-7.1A, 2.5V-1.75A	4.95
CT-137	350VCT	.075 MA	5V-3A	2.75
CT-102	1080VCT	.055	25V-3A, 6.3V-1.8A, 6.3V-1.2A	5.95
CT-966	330V	.060	6.3V-1.2, 6.3V-600 MA	2.75
CT-319	330VCT	.085	5V-2, 6.3-7.5, 6.3/.3	3.25
CT-526	510VCT	.025	12.5 / 300 MA, 6.3 / 5A	1.95

Filament Transformers—115V/50-60 cps Input

Item	Rating	Each
FT-652	23V 5.5 A	$1.79
FT-308	58V 2.2A	2.75
FT-599	78V / 300, 6.3V 2A	1.95
FT-719	1.3V 6A	.79
FT-679	13.5V 1.11A	.79
FT-674	2.5V 10A, 6.3 5A	.79
FT-23-1	6.3V-3A	1.10
FT-367	5VCT 3A, 58VCT 40A	1.10
FT-345	5VCT 13-5, 5VCT 3A, 5VCT, 6.75	1.95
FT-781	866 Trans. 2 x 2.5 / 5A	2.25
FT-35-4	6.3 / 2, 6.3 / 4.5	1.49
FT-11	3.4V 300A, 7 / H x 10" x 5" / W	14.95
FTG-11	2.5V 2.5, 7V 7A (Tape @ 2.5V / 2.5A), 16 lbs.	9.95
FT-674	8.1V / 5A	1.10
FT-157	4V 16A, 2.5V 1.75A	2.95
FT-781	6.4V 3A	1.10
FT-736	2 x 6.3VCT 3.2 1.2A	1.49
FT-461	2 x 6.3VCT 1A	1.10
FT-899	2.5V / 5A 29000 Rms	3.95
FT-735	6.3VCT 1A, 6.3VCT 7A	1.79
FT-735	6.3VCT 5A, 6.3VCT 1A	1.79
FT-101	6V / 25A	.79
FT-1-61	6.3VCT 1, 2.5V 2	1.98
FT-774	6.3V 16A	.79

Plate Transformers—115V/50-60 cps Input

Item	Rating	Each
PT-976	Auto: 120VCT, 10 MA	$ .69
PT-31A	2 x 300V / 5 MA	.79
PT-46A	4080VCT N.L. 3.15 to 1.8" H x 6" W x 7" L 20 lbs.	29.95
PT-033	4150V / 400 MA 11½ x 9¼ W x 9" D 70 lbs.	49.95
PT-75-2	3780-3446-3112VCT, 77 MA	10.95
PT-78-1	4600VCT / .077	12.95
PT-403	Auto: 70V-1A	2.29
PT-160	1120VCT-770 MA, 580VCT-82 MA, 25 lbs.	24.95
PT-170	Auto: 156-146-127-120-71A	3.75
PT*448	3140VCT-750 MA for 5C545, BC166A	69.95
PT-139	42V-46V-50V-55V-15.2A 7¼x7" W x 5½" H	10.95
PT-637	400V-20 MA	.98
PT-69	5W-1.6A	.49
PT-31A	2 x 300V-5 MA	.79
PT-976	120VCT-10 MA	.79
PT-67-1	62V-3.5A	2.95
PT-128	2800VCT-1.2A	2.95
PT-104	690V-450 MA	4.95
PT-054	980V-450 MA	5.25
PT-997	78V-.0075A KVA	1.49

SPECIAL TYPES

Item	Pri.	Output	Price
STF-946	210-220-230	2.5V-4A 3½" H x 2½" x 2½" D	$1.29
STF-443	220/440	11VCT 125A 6½" L x 5½" x 8" 15 lbs.	15.95
STF-638	230	2.5V-9A 3" x 3" x 2½"	2.25
STF-05A	115-230	2 x 5V-7.5 7" H x 7" x 5" D	4.25
STF-682	220	30-25-20V-1 MA	.69
STF-968	230	2.5V-6.5A	1.10
STF-405	230-115	12.6V-9A	1.95
STF-370	220-440	3 x 2.5V-5A, 2.5V-15A, 5½ x 5 x 4½	5.25
STF-619	110-220	2.5V-500A, 7 x 5½ x 5	19.95
STF-1120	230	2 x 6.3V-.05 / 2 x 6.3A, 12.6 / 1A	2.95
STF-631	230	2 x 5V-27A 2 x 5V-9A, 103-4H x 5 x 7 30 lbs.	24.95
STF-968	230	2.5V-6.5A	1.95
STF-608	220	2.5V-6.5A, 5V-3A, 2 x 6.3V-1A	2.75
STF-45A	43-78-95	2 x 2.5 / 6.5, 6.3V-4 7 Fan.	3.25
STF-306	105-120-230 / 100-120-230 / 200-240	5VCT 10 amp 20000 VCT	3.95

Item	Pri.	Output	Price
STP-945	210-220-30	1100VCT-300 5½ x 4 x 3½	$5.95
STP-444	230-460	230-105-115/125 15 lbs. 5½ x 6 x 4½	14.95
STP-613	230V	2 x 230 / 05	1.79
STP-627	115V	1100VCT-300 MA	2.95
STP-780	82V	4000V-002	1.29
STP-088	50V	2 x 250V-1 MA	.98
STP-311	30-35-40	95 VL-50VCT-1 Amp COMB.	.59
STC-627	230V	1500-160, 110V-200, 3.3V-200, 5V-10, 2.5-1.4-10	$5.95
STC-811	230V	250VCT-90 x 6.3V-9	2.95
STC-16A	22-2V	260V-03, 100V-1, 6.3V-4.2	2.95
STC-607	220V	700VCT-75 MA, 80VCT-100, 15-10-10V-10A	3.95
STC-612	230V	60V-30, 150-30, 2 x 5V-2.5 w/2-base Socket	3.95
STC-622	230V	250V-100, 2 x 5V-2 9.2.4 Prg. Sockets	4.25
STC-047	200V	70V-90 MA, 110/-80 MA, 24V-6C MA, 2 x 6.3/-3-1A, 5V-3, 5V-5A, 2.7-5A	4.95

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.25	20K	16.95
.5	25K	12.50
1	25K	25.00
4	50	.29
1	100	.25
2.5	100	.23

200VDC

2x.25	2ST	.25	
2x.1	3ST	.15	
2x.1	4ST	.20	
2	2ST	.20	
2x.1	2ST	.20	
.5	2TT	.15	
2	2ST	.25	

400VDC

2x.25	2ST	.21
2x.1	3ST	.20
2x.1	2TT	.20
2x.1	2ST	.20
1	2TT	.15
1	2ST	.25
2	2ST	.29

600VDC

1	2BT	.20
1	2ST	.21
2x.1	2ST	.27
2x.1	3ST	.27
2x.1	2HT	.27
2x.1	2ST	.25
3x.1	8T	.25
2x.25	2ST	.25
1	2TT	.30
1	2ST	.30
2x1	2ST	.35
2	2ST	.40
2	2BT	.30

1000 VDC

1	2ST	.45

MANY OTHERS

T.V. Transformer, 110-60 cy 7" or 9" 2 sec. 3000v 5 MA, 720 vct 200 MA, 6.4 6.7 A, 6.4 6A, 5 3A

1.25 .3A. Now **$3.95**

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0-5 MA & 0-5 V Scale w/ 110V Movement 2" Metal Case Bakelite Meter 98c ea.
9" 2 sec. 3000v 5 MA $9.00
0-250V 3½" 2 ½" Rd Flush Mtg. $4.25
0-5 MA Basic 3½" Rect. Flush Mtg. $4.25
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0-150 VAC 3½" Rd Bake Enamel $4.25
0-5 MA Basic 3" Rd Flush Mtg. $4.25
0-5 MA Basic 3" Rd Metal Shell Mtg. $4.25
0-7 mill. Scales 0-100 Meg. 0-600V Range $4.25
0-1 VDC $4.25
0-5 MA Basic 3" Rd Flush Mtg. $4.25
0-1 mill. Scales 3-1-0-3 Meg / 600V 3 MA $4.25
100-0-100 Microamps 4½" Rect. Bake Wrinkle Finish $8.95
0-200 Microamp 4½" Rect Bake $10.95
0-200 Microamp 4" Rect Bake, Weston 301 ..... $12.95
0-300 VDC 4" Rect Bake Weston 741 ..... $13.95
0-1 MA 3" sq Cal. Mod DO-53 ..... $5.95
0-10 MA 3½" Rd Bake Delpire 3310 ..... $3.95

MICROWAVE WRITE FOR FLYERS OF SURPLUS PLUMBING AND ACCESSORIES

WOW! What Savings!

CABLE CLAMPS
Tins .5, 1, 3, 4, 6, 7A, Lock Type Rubber 6c ea. 10 for 55c.

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BC433 Mod or unmod CW Reception 200-1750KC in 5 bands 14 or 24V & 220V AC Input. Radio Compass As Is. Less Tubes. Post Condition $11.95

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w/Cover, Dix. to 110V 60 cy. .....

Motor Driven Vane Switch 24V 1800 RPM. Price $3.95

BC434 CONTROL BOX
Remote Control for 433 Receiver Contains Relays 0-3MA Meter, Dial Control $3.95

BC659 Transmitter & Rec. including Power Supply less Tubes. Transmitter & Condenser: 27-39 MC. FM Xtal Controlled 2W. SCR 610. Operates 6-12-24 volts. PE120 Dynamotor 900 40MA, 250V 40MA, 6V 250MA 1.5V 900MA. $20.95

1M Freq. Meter. No calibration Book used. Fair As Is. Less Xtal. Special $19.95

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GPT Aircraft XMTTR. Good Condition. As Is. Less T. U. $17.50

Avail. in Stock. Dual XMTTR & Dual Rec. Triple Bank MT-1 Command RT-6/ARC-1 Unit & Ranger Dy. Sply. 3A In. No Info Send. Repairable $1.00 ea.

400 MA 12 HY Choke $9 ohms Hermt. sealed Special $3.75

ARR2 Homing Receiving
Tunes 234-258 MC, 4-6AK5, 6-6001, 1-12A6. Ideal for 2-6-10 Mtr. Conv. Less tubes as is ..... $5.95. Less Dyn. Less Tubes as is $3.95

GIBSON GIRL
The Emergency Radio Transmitter. Send S.O.S. Range 200 miles easily on 500 KC. 150-mile range. Transmitter is required. Has hand-driven generator, tubes, new. It's only $3.25

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105-475 MMF	20c
7-70 MMF	20c
22-105 MMF	20c
12-145 MMF	20c
15-160 MMF	20c
5-50 MMF	20c
Set of 6 for	$1.00

VARIABLE TRIMMER CONDENSERS

20 MMF	19c ea.
15 MMF ±80	20c
50 MMF C-CO	20c
60 MMF ±203	24c
40 MMF ±740	30c
5 MMF ±112	40c
3-25 MMF	50c
air, Ceramicon—	
2-20 MMF	14c

DS Filter Condensers

40-20	150	19c
20	150	19c
2x20	150	29c
2x30	150	29c
40-20	150	39c
2x40	150	39c
30-50	150	39c
2x50	150	39c
3x20	150	39c
3x30	150	39c
50-2x40	25/150	39c
2x40/12	150	39c
2x40-20	150	39c
2x50	150	39c
2x50-20	150/25	39c
2x40-30	150	39c
60-30/150	150/25	39c
80-40-30/100	150/25	39c
40-30	200	39c
20-10/10	200/25	39c
2x30	350	39c
2x32	350	39c
50-30	450	49c
20	450	49c
16-8	450	49c
2x16	450	55c
32-16	450	55c
2x8-25	450-75	49c
20-20/20	450-25	49c

Many Others

ARC 5 Transmitters 40 Watt Output These Famous V.F.O. Drivers Available

3—4 MC $5.95
Cord. Good cond. As Is.

Birtcher Tube Clamps In Stock ..... ALL SIZES SEND YOUR REQUIREMENTS

BC 429 RCVR.
(SCR183)
Compl. with T.U. C-439 Dual: 250-400 & 2500-4700 KC.
Ex. Cond. $3.95
Extra Tuning Unit $4.95

DYNAMOTORS

Type	Input Volts	Amps
PE 86	28	1.25
DM 416	14	6.7
DY-2/ARR-2	28	1.1
DM 36	28	1.4
DM 53AZ	14	2.8
PE 73CM	28	10
DM 21	14	3.5
DM 25	14	2.5
DM 28R	28	1.25
DM 33A	28	7
DM 42	14	10
PE 101C	11/28	12.6 / 6.3
GD AR 93	28	3.25
23350	27	1.75
15X045B	28	1.2
ZA .0515	12/24	4/2
ZA .0516	12/24	8/4
G-19 pack	12	9.4
D-104	12	
DA-3A*	28	10
#5053	28	1.4
CW 21AAX	14	12.6
	28	6.3
GD 27KM	14	40
PE 94	28	10

AC CONDENSERS

75-84	125	1.30
20-24	120	1.00
26-30	115	1.00
31-37	110	1.00
38-42	110	1.00
43-46	110	1.00
47-65	110	1.00
50-75	110	1.25
72-87	110	1.25
86-96	110	1.45
98-106	110	1.50
107-179	110	1.75
126-138	110	1.75
130-150	110	1.80
151-160	110	1.75
158-191	110	2.00

Write for many others.

TELEVISION CONDENSER

MFd	Volt	Price
5000	15	$1.20
1000	0	.85
500	0	.65
2000	0	1.35
225	15	.90
800	15	.75
1000	15	.95
500	50	.95
6000	12	1.15
9000	12	2.00

29c ea.
10 for $2.75

MFD.	VOLT
6	400
4	450
40	450
30-70	150
30-50	150
20-20	350-25
20-20	400-25
40-20-10	150
60-30-20	150-25
50-50-20	150-25
60-40-10	150-25
60	300
40	450
32	450
30-30	150
30-30	150
40-20	350-25
10-10	450
40-20-20	150
60-30-20	150
3850	250
40-20-10Q	150-10

MANY OTHERS

MICA CAPACITORS SOLAR XMB TAPPED FOILED

Mfd.	Price
2500 V Test	
.00001	$0.35
.000025	.35
.00050	.35
.00005	.35
.000075	.35
.0001	.35
.00015	.35
.00025	.35
.0003	.35
.0004	.35
.0005	.40
.00075	.40
.00085	.40
.001	.50
.0015	.50
.0016	.50
.0017	.55
.002	.65
.0021	.65
.003	.75
.004	.95
.0045	.95
.006	.98
.0061	.98
.0069	.98
.007	.98
.0075	.98
.0076	.98
.008	1.05
.01	1.05
.015	1.25
.02	1.30
.025	1.30
.027	1.30
.03	1.45
5000 V Test	
.0015	1.75
.002	2.00

Solar XQ Solder Lugs 2500 V Test

.01	1.25
.015	1.30
.02	1.50
.025	1.50
.001	.60
.0015	.65
.002	.75
.0022	.75
.0023	.75
.0024	.75
.0025	.75
.0027	.80
.003	.80
.004	.85
.005	.90
.0056	.90
.006	.95
.0065	1.00
.0075	1.00
.0076	1.00
.008	1.00
.0085	1.20
.0095	.60
.00085	.70
.00015	.60

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diagram may be located in the same manner.

Tube types are listed both alphabetically and numerically, permitting the booklet to be used like a dictionary or telephone directory. A 4-page cross index in the back of the book lists additional types, together with a key to appropriate diagrams in the book.

Copies of the "Triple Pindex" are available from *RCA* distributors at a cost of 75 cents.

CONTACT SWITCHES

Guardian Electric Manufacturing Company of 1621 West Walnut Street, Chicago 12, Illinois, has recently issued a bulletin entitled "Contact Switches by *Guardian*" which is available on request.

Numerous line drawings and charts are employed to give information relative to sizes, designs, and materials available in standard contact blades, lug adapters, and insulating separators. Also included are details on the "Engineer's Kit," a unit containing working samples of bushing stock, mounting brackets, contact assemblies and fixtures, fish paper, contact blades, lifters, etc.

STANCOR TRANSFORMERS

A new edition of the *Stancor* transformer catalogue is currently available from *Standard Transformer Corporation* of 3580 N. Elston Avenue, Chicago 18, Illinois, or from any of the company's distributors.

This 20-page catalogue, designed especially for those in the radio, sound, and industrial electronics fields, lists complete electrical and physical specifications on more than 400 part numbers. Also included is a complete price list and handy charts.

A.C. POWER PLANTS

The growing interest in standby power plants in national defense and war production applications makes the new catalogue just issued by *Kato Engineering Company* of 1415 First Avenue, Mankato, Minnesota, of particular value at this time.

The new catalogue lists all types of a.c.-d.c. generating plants which provide from 500 watts to 25,000 watts output. Included are units suitable for use in homes, on farms, for institutions, as well as water-cooled plants for heavy-duty applications.

Pertinent data on operating costs, installation and service, generator types available, accessories, and fuel is also included. For a copy of this catalogue, write the company and ask for Form 650-X "Katolight."

AIDS FOR THE BLIND

The Special Services Department of the American Foundation for the Blind, Inc., 15 West 16th Street, New York 11, New York, has just issued a catalogue which lists the various aids for the blind that are currently available from that organization.

Of particular interest to persons in

the radio and electronics field are the listings covering an auditory circuit analyzer for blind radio technicians and sightless hams, a braille slide rule, a modified micrometer with raised graduations around the barrel, a stapled tape measure, and a collapsible cane which technicians will find helpful as it can be telescoped to fit into a pocket.

Copies of the catalogue as well as all of the merchandise listed are obtainable from the Special Services Department at the address listed before.

TUBE DATA

The *RCA* Tube Department has just issued a revised edition of its quick-reference booklet, "RCA Receiving Tubes for AM, FM, and Television Broadcast."

Designed for the service technician, engineer, student, or ham, this new 24-page booklet covers more than 450 *RCA* receiving tubes and picture tubes, including more than 50 new types. It provides a means of easy checking as to the characteristics and socket connections for each tube type as well as a classification chart which groups the tubes according to their family class, their functions, and their filament or heater voltages, thus facilitating the determination of the type designation of a tube for a desired purpose.

The booklet, Form 1275-E, may be obtained from the company's tube distributors or by sending 10 cents in coin to Commercial Engineering, *RCA* Tube Department, Harrison, New Jersey.

POWERSTAT TRANSFORMERS

A 16-page bulletin, featuring the company's complete line of "Powerstat" variable transformers, has just been released by *The Superior Electric Company* of Bristol, Connecticut.

The new bulletin P550 describes in detail both manually operated and power driven variable transformers as well as the company's line correctors. Also included is data on "Voltbox" a.c. power supplies, oil-cooled "Powerstats," and the recently-introduced explosion-proof units. Photographs, performance curves, graphs, wiring diagrams, and similar descriptive illustrations make this a handy reference manual.

JERROLD CATALOGUE

Jerrold Electronics Corporation of 121 North Broad Street, Philadelphia 7, Pa., has just issued a comprehensive catalogue covering its "Mul-TV System."

Included in the new two-color catalogue is full information on the installation and operation of the system as used in apartment houses, hotels, and other multi-unit buildings, as well as in the stores of television dealers. The booklet shows diagrammatically how a "Mul-TV System," including antenna, master control amplifier unit, and distribution outlets, is installed in a typical apartment house or store.

Copies of the new catalogue are free of charge and may be secured by writing the company direct.

ONAN PAMPHLET

D. W. Onan & Sons Inc. of Minneapolis 5, Minnesota, has issued a four-page folder describing how any business, factory, institution, farm or home can be protected against property damage, production losses and danger to human life which are the frequent results of electric power failures.

The company's new standby generator, specially designed for tractor-belt drive, is described and illustrated in the folder.

When requesting copies of this pamphlet, please ask for Standby Folder A-277.

"SERVICE NEWS"

The first issue of the monthly "*Telrex* Service News" made its appearance recently as a house organ for *Telrex, Inc.* of Asbury Park, New Jersey.

The new brochure is prepared for the thousands of "Conical-V-Beam" dealers and service technicians throughout the nation with its contents written expressly for those who use the company's products. Each issue carries a column "Tek-Talk" by M. D. Ercolino, an antenna range map for major TV areas, antenna performance graphs, miscellaneous product news, "Tricks of the Trade," and a question-answer column.

Dealers and technicians who have not received the "Service News" may obtain a copy free of charge from their *Telrex* distributors.

IRC CATALOGUE

International Resistance Co. of 401 N. Broad St., Philadelphia 8, Pa., has issued a new data sheet giving details on the company's "Concentrikit" stock assortment.

The stock assortment covered by the catalogue contains all necessary parts for easy assembly of any of 144 different concentric dual controls.

A copy of Catalogue DC2S is available to service technicians on request.

—30—

HARVEY RADIO OPENS NEW SOUND DEPARTMENT

AN "Audio-Torium," representing the latest techniques in the demonstration and merchandising of audio equipment, was formally dedicated last month in New York by Harvey Radio Company.

Located in the heart of the Times Square district, the new "Audio-Torium" represents a complete departure from the "horse-and-buggy" type of sound room which has prevailed in the past.

The "Audio-Torium" features a decorated acoustically-treated ceiling, indirect fluorescent lighting, and blonde oak-paneled walls. In technical design, no effort has been spared to avoid the bailing-wire or breadboard technique for interconnecting tuners, speakers, amplifiers, recorders, etc.

All components on display are permanently connected to a large central control panel which permits instant selection of any among thousands of possible audio equipment combinations. Among the unique technical features of the "Audio-Torium" is the use of low-capacity coax-type cable in both input and output circuits to assure freedom from high-frequency attenuation. The means of assuring impedance match by feeding the signal from low-level pickups through cathode followers prior to introduction into amplifier circuits is also a unique feature.

Construction of the "Audio-Torium" required the use of more than 10,000 feet of low-capacity cable, 568 Cannon type XL connectors, 300 d.p.s.t. toggle switches, 300 closed circuit jacks, and other miscellaneous items in impressive quantities.

—30—

Among the visitors who attended the opening of Harvey Radio Company's "Audio-Torium" was Lincoln Walsh (left), designer of the Brook all-triode amplifier, who is shown discussing audio merchandising with Roy Neusch, director of Harvey's sound department.

PRACTICAL HOME-STUDY RADIO COURSE

WORTH MUCH MORE

"You should get more money for your Course. The first week I studied it, I made $10.00 repairing sets. I built my own test outfit from details given in this course. I have repaired 100 radios to date." Signed: *Robert C. Hammel*, 120 W. 13th, Davenport, Iowa.

COMPLETED IN 8 WEEKS

"I am very satisfied with the course. When I was at the twelfth lesson I started repairing radios. It took me two months to master your course." From a letter written by *Roger Lourlaix*, 1679 Pesport, Montreal, Canada.

"I have found since taking your course how modern and up to date it really is. There is not one page in the whole course which anyone interested in radio can afford to miss. Your course started me on the road to a well paid job and has repaid me many times." *Charles Unpech*, 433 Elm St., Reading, Pa.

AMAZING BARGAIN OFFER

Here is your practical home-study **course** at a give-away price. The 22 lessons cover all topics just like other correspondence radio courses selling for over $150.00. Our amazing offer permits you to obtain the **course** complete for only $2.50, nothing else to pay. Course covers fundamentals, modern circuits, practical radio repairs. Includes hundreds of diagrams, thousands of *repair hints*, many trouble-shooting short-cuts.

IN MANUAL FORM

$2.50 COMPLETE

SPECIAL OFFER

READ THE DETAILS

RADIO TRAINING FOR HOME-STUDY

The easy-to-follow lessons of this home-study **course** will show you quickly how to repair all types of radio sets. There are lessons on how to open a shop and operate a successful radio business. Every lesson is well illustrated, interesting to read, really easy to understand and apply. No special previous knowledge is needed. The early lessons explain important principles. Other lessons cover test equipment, trouble-shooting, circuit tracing, television, and every important topic of radio servicing.

PRACTICAL ON-THE-JOB MATERIAL

Learn new speed-tricks of radio fault-finding, case histories, servicing short-cuts, extra profit ideas. Included are many large lessons on the use of regular test equipment, explanation of signal tracing, use of oscilloscope, transmitters, P. A., television, recorders, etc. Let this information save for you enough time on a single job to pay the full price of $2.50, for the complete **course** of these money making lessons.

EASY TO UNDERSTAND AND APPLY

The practical lessons of this course-manual are easy to follow and apply to actual radio jobs. Hundreds of radio and television facts that puzzled you will be quickly cleared up. You will find yourself doing radio repairs in minutes instead of hours—quickly finding faults or making adjustments. Every new radio development of importance and thousands of time-saving facts are packed into this giant-size complete course-book.

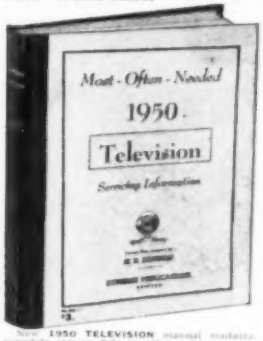
SATISFACTION GUARANTEED

Use the **no-risk** coupon below to order the **Course** for 10-day examination in your own home. Look over this material, read a few lessons, use this aid to fix a few radios. Only then decide to keep the lessons at the bargain price of $2.50 (full price), or return the material for a cash refund.

SUPREME TELEVISION MANUALS

MOST AMAZING MONEY-SAVING BARGAINS

The **television series** manuals are the most remarkable values offered by **Supreme Publications** in their 17 years of business. These TV manuals at only $3 and $2 each are amazing bargains and defy competition. There is nothing else like them. Each manual is a virtual treatise on practical television repairs. By normal standards, each such large manual packed as it is with practical facts, hundreds of illustrations, diagrams, charts, photographs, and expensive extra-large blueprints, should sell for $10—but as SUPREME special values they are priced at $3 and $2 each. Only a publisher who sold over one million TV and radio manuals can offer such bargains based on tremendous volume-sales.



New **1950 TELEVISION** manual contains complete service data on all popular present-day television sets of all makes. Includes description of modern circuits, test patterns, response curves, many oscilloscope waveforms, alignment tables, service hints, diagrams in the form of double-spread blueprints, test prints, voltage charts, etc. Large size, 8½x11". manual-style binding, flexible covers, at your jobber or by mail, only **$3**

New 1950 T-V Manual

This newest giant volume of the series covers 1950 television factory data. Here is everything you need to repair and adjust all present day TV sets. Covers all popular makes from Admiral to Zenith. There are circuit explanations, 144 pages of alignment procedure, many test patterns, response curves, pages of waveforms, voltage charts, hints, factory recommended changes, and ten mammoth 11 x 15-inch blueprints. Available at your radio jobber or postpaid. See coupon. Price only **$3**

Compiled by M. N. Beitman, radio engineer, teacher, author, and serviceman.

1949 T-V Manual. Similar to the volume listed above. Has 160 extra-large pages, plus 9 double-spread giant blueprints. To order see coupon at right, only.... **$3**

1948 T-V Manual. Earlier volume has material on all popular TV sets of this period. Large size: 8½x11". Remarkable value, see coupon at right, only..... **$3**

1947 F.M. and T-V Manual. Covers popular F.M. and television sets including R.C.A. 630TS. Data on 192 pages. Only.. **$2**

Supreme Publications

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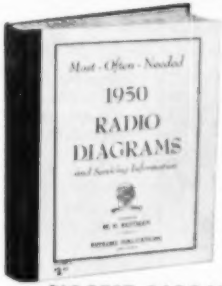

New 1950 Radio Diagrams

Now you can benefit and save money with **Supreme** amazing scoop of 1950. This one giant volume has all the service data you need on all recent radio sets. Here you have clearly-printed large schematics, needed alignment data, parts lists, voltage values, and information on stage gain, location of trimmers, and dial stringing illustrations. This is the help you need to find tough faults in a jiffy. The new 1950 radio manual is a worthy companion to the 9 previous volumes used to an advantage by over 128,000 shrewd radio men.

BIGGEST BARGAIN IN SERVICE DATA

You get best values at lowest prices in **Supreme Publications** manuals. For the remarkable bargain price (only $2 for most volumes) you are assured of having on hand needed diagrams and all other essential repair facts on 4 out of 5 sets you will ever service. Every popular radio of all makes from old-timers to new 1950 sets is covered. Select manuals wanted, see below. Rush coupon today to try manuals for 10 days.

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1949 1948 1947 1946 1942 1941 1940 1939

SUPREME Most-Often-Needed RADIO DIAGRAMS Each Manual only $2. 1949 is $2.50 ; 192 pages of diagrams, alignment data, voltage values, parts lists, and service hints; large size, 8½"x11". To order, see coupon below.

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☐ **1948 TV**, $3. ☐ **1947 TV & F.M.**, only $2.

☐ I am enclosing $..... Send postpaid.
☐ Send C.O.D. I am enclosing $.... deposit.

Name: .....

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☐ 1947
☐ 1946
☐ 1942
☐ 1941
☐ 1940
☐ 1939

RADIO MANUALS

PRICED AT ONLY $2 EACH

☐ 1926-1938 Manual, $2.50

Within the Industry
(*Continued from page 28*)

have made outstanding contributions to the productive arts in their fields.

* * *

ROCKWELL M. GRAY of the *Raulang-Borg Corp.* of Chicago was recently named chairman of the Association of Electronic Parts and Equipment Manufacturers at the annual meeting of that trade group. John H. Cashman of *Radio Craftsmen, Inc.*, Chicago was chosen vice-chairman while Helen Staniland Quam of the *Quam-Nichols Co.*, Chicago was reelected treasurer for her fifteenth annual term. Kenneth C. Prince was reelected executive secretary and legal counsel for the group.

James M. Blacklidge, of *Gramer Transformer Corp.*, the 1949-1950 chairman, reported that the association's mobilization committee has been in conference with the armed forces procurement groups and government officials in Washington laying the groundwork for all-out cooperation in the production of military communications equipment. Mr. Blacklidge pointed out that EP & EM members and other electronic producers in the Chicago area led the nation in the production of military communications materiel during the last war, and that on the basis of present production capacity the same group can meet any schedule the Washington planning group assigns.

* * *

SIGHTMASTER CORPORATION has recently moved its sales office and showroom to 111 Cedar Street, New Rochelle, New York . . . **CASCADE TELEVISION CORP.** has moved its production facilities to a new and larger factory at 153 Chestnut Street, Irvington, New Jersey . . . **RCA** has expanded its receiving tube production facilities by the large-scale installation of new and improved automatic tube-making machinery at the company's Harrison, N. J. and Indianapolis, Ind. receiving tube plants . . . **ATOMIC INSTRUMENT COMPANY** has moved to new, larger, and more conveniently located quarters at 84 Massachusetts Avenue, in Cambridge, Massachusetts . . . **BICKFORD BROTHERS,** wholesale distributors in the Buffalo and Rochester areas, has been purchased by the **RCA VICTOR DISTRIBUTING CORPORATION** . . . **FIELDEN INSTRUMENT CORPORATION** of Philadelphia plans to expand its line of products now that it has taken possession of new and larger office and factory space at 2920 North 4th Street . . . **JFD MANUFACTURING CO. INC.** has taken over the entire first floor of the modern **AIR KING** building located at 6315 Fifteenth Avenue in Brooklyn and has thus ac-

quired an additional 36,000 square feet of production space . . . **GENERAL ELECTRIC COMPANY** has purchased the **ILLINOIS CABINET COMPANY** of Rockford, Illinois as a supplier of television and radio cabinets. *G.E.* has been a partial owner of the cabinet company since 1947 . . . A new entrant into the electronic components manufacturing field in **TETRAD COMPANY, INC.** of 4921 Exposition Blvd., Los Angeles. The new company will manufacture miniature solenoid coils . . . A new building, providing 20,000 square feet of additional production space, is now in operation at the main Plymouth factory of **JOHN MECK INDUSTRIES . . . SHOBE INC.**, *Philco* distributor in the Tennessee area, has just opened a new distributing plant in Memphis . . . **RADIO-MATIC OF AMERICA, INC.** has just acquired plant facilities for the production of radio and television cabinets at 760 Ramsey Avenue, Hillside, New Jersey . . . **GENERAL ELECTRIC COMPANY** has announced a three million dollar expansion program for its receiving tube plants at Owensboro, Ky. and Tell City, Ind., involving the addition of 134,000 square feet of floor space and new tube making equipment.

—30—

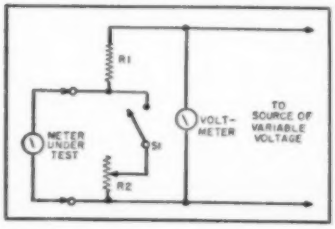
METER CHARACTERISTICS

By LEON G. WILDE

OFTEN it is desired to know the sensitivity and resistance of a meter movement. The resistance cannot, in general, be determined with an ohmmeter, as the current sent through the meter movement by the ohmmeter will frequently be sufficient to cause permanent damage. The method described measures both the resistance and sensitivity with no possibility of damage to the meter. R_1 is a precision resistor having a value of at least 100 times the expected meter resistance, and R_2 should have a resistance of approximately twice the meter resistance. The variable voltage can be obtained from an adjustable power supply or potentiometer voltage divider. In operation, the adjustable voltage is set to a minimum, the meter is connected with S_1 open, and the voltage is increased until the meter reads full-scale. The sensitivity (full-scale deflection) will equal the voltmeter reading divided by the value of R_1. S_1 is then closed, and R_2 adjusted for half-scale reading on the meter, after which S_1 may be opened, and the resistance of R_2, which is now equal to the meter resistance, may be read on any ohmmeter without danger.

—30—

Setup for determining meter characteristics.



Technical BOOKS

"PRACTICAL TELEVISION ENGINEERING" by Scott Helt. Published by *Murray Hill Books, Inc.*, New York. 694 pages. Price $7.50.

The author of this text is with the Research Division of *Allen B. Du Mont Laboratories, Inc.* as well as serving as Instructor-in-Charge of Columbia University's "Principles and Practice of Television" course.

With this diversified background it is easy to see why this text has proved to be such a practical expose of the subject. The text material is fairly comprehensive and covers the fundamentals of picture transmission, the cathode-ray tube, the CR oscillograph, the electron tubes used for image pickup, the synchronizing generator, the video amplifier and cathode follower, the voltage regulated power supply, the TV receiver, the TV camera chain, the TV transmitter, and finally television broadcasting techniques.

Designed for the manufacturing and sales engineer, broadcasting engineer, student, and technician, the text covers transmitting and broadcasting problems thoroughly and in easy-to-understand language. Both the theoretical and practical aspects of lenses, lighting, CR tubes, transmitters, receivers, etc., are included.

An excellent bibliography and a group of review questions accompany each chapter so that the student who is using this book as a home-study text can check his grasp of the subject matter.

This book will undoubtedly find its way into the libraries of technical television personnel throughout the country and provide a sound addition to the existing literature on the subject.

* * *

"MOBILE RADIO HANDBOOK" edited by Milton B. Sleeper. Published by *FM-TV Magazine*, Great Barrington, Mass. 165 pages. Price $2.00 paper, $4.00 cloth.

This thoroughly practical handbook has been designed to assist company executives and public officers responsible for the planning and purchasing of communications equipment as well as the communications engineer, system supervisor, operator, and maintenance man who must keep such equipment in operation.

With more than 12,000 main stations and over 200,000 mobile units currently in use, the need for such a text can hardly be questioned. The fact that the new FCC rules and allocations will undoubtedly create an even larger demand for this type of equipment makes the appearance of this book particularly timely.

The first three chapters cover factors which must be considered when planning mobile or point-to-point sys-

HERMETICALLY SEALED CHOKES

10 H.	100 M.A.	**59c**
59 H.	100 M.A.	**95c**
3.7 H.	145 M.A.	**59c**
10 H.	20 M.A.	**39c**

A Repeat Item by Popular Demand
A limited supply of Navy "LM" Frequency meters will go to the first comers at **$12.95** ea. These units must go on an "as is" basis at this Low Price. They are less tubes, crystal and calibration book. Some are minus knobs and dial but have very clean—new looking insides.

HEADSETS—MIKES

HS-23 Hi Imp. Headsets	New	**$2.95**
HS-33 Lo Imp. Headsets	New	**2.95**
HS-30 Hi Imp. Headsets	New	**1.50**
	Used	**.79**
T-17D Carbon Mike	New	**2.75**
	Used	**1.50**
T-24 Hi Imp. Carbon Mike	New	**1.19**
T-30 Throat Mike	New	**.98**
T-45 (or Navy) Lip Mike	New	**.98**

Portable VHF Communication Unit

Two-way radio telephone equipment designed for operation between 152 and 162 megacycles. Adaptable for many uses, a complete unit including the rechargeable storage battery weighs but fifteen pounds, and is housed in a sturdy case 11½"x9"x4¼", provided with shoulder straps.

This brand new set of big name manufacture comes complete with battery, battery tray, and handset but less crystal **$89.50**
Battery charger is extra at **$19.95**

Mobile VHF Communication Unit

Adaptable for many mobile uses, this is a compact unit 3½"x8"x15½", operating on 152 to 162 megacycles. It is six-volt powered direct from storage battery, and is complete with the tone filter and crystal, handset, control box, antenna and installation kit.
Brand new, ready to go **$129.50**
Extra 18" stub type antennae are available **$2.95**

Miscellaneous SPECIALS

	Used	New
ID 6 APN 4 Scope, Excellent	**$29.50**	
R 7 APS 2 Receiver-Indicator		**$79.50**
R 78 APS-15 Receiver-Indicator	**34.50**	
BC 1287 A Scope	**75.00**	
ASB 7 Indicator Scope	**12.95**	
SCR 522 Transceiver 100 to 150 MC.	**34.95**	**75.00**
BC 1206 Receiver, 200 to 400 KC.		**5.95**
MN 26 C	**17.50**	**24.95**
RA 10 DA Receiver	**17.50**	**24.95**
RT7 APN1 Transceiver	**4.95**	**9.95**
APN 1 Complete		**24.50**
BD 71 6 Pos. Switchboard	**9.95**	**12.95**
EE 8 Field Phones	**7.95**	
BC 347 Interphone Amplifier		**2.95**
I-70 Tuning Meter		**.89**
AM 61 Indicator Amplifier		**9.50**
SCR 625 Mine Detector		**39.50**
BC 461 Vreder Root Counter		**.59**
BC 442 Less Condenser	**1.49**	**1.95**
APS 13 UHF Antenna, Pair		**.98**
FL 8 Filter		**2.95**
I-97 Bias Meter	**3.95**	**4.95**
RM 29 Remote Telephone Control	**7.95**	**9.95**
BC 602 Control Box		**.98**
RIA 42 Antenna Gearbox Motor and Reel	**4.95**	**7.50**
TS 10—Sound powered phones	**$6.50**	
APS 13—Transceiver		**$17.50**
BC 1066 A—150 to 225 MC Portable Receiver adaptable to many amateur uses. In Canvas Carrying Bag. New		**$6.95**
Tuning Units for **BC 375**—Presently most numbers are available in excellent condition with case at		**$2.95** ea.
BC 306—Antenna Tuning Unit for Excellent condition		**BC 375 $1.50** ea.
One Tube Interphone Amplifier—Small compact aluminum case fully enclosed. 2¼"x3¾"x5¾". Less Tube		**79c**
BC 717 Transmitter, New but less Tubes		**$24.50**
96Q1 Complete Autotune assembly with motor and frame as used in **ARC-1** Transmitter. New		**$35.00**
BC 709 Battery operated lightweight interphone amplifier. Complete with tube and shock mount, but less battery		New **$2.95**
$183 Complete		New **$49.50**
Motor—Universal Electric, 24 VDC, will also operate on 24 VAC Diameter 1⅝". Length 2⅝". Shaft ¼"x¾"		New **$1.49**
MC 385A—Headset Adapter		New **49c**

Information and Prices on Request

BC 619 Receiver with **RA 42** Rectifier
RTA 1B Transceiver
TA 2J24 Transmitter and **MP 10G** Power Pack
SCR 269 Compass Installation
R 5 ARN 7 Compass Installation
MN 26 Compass Installation
I. L. S. Installation **(R 89-BC733)**
MD-22-URA 71 Radar Modulator
AN APR1 Receiver and Tuning Units
ASB7 Complete Radar Installation
TS-251 Test Set — **BC 221** Freq. Meter

ARROW has the VALUES!

RADIO TUBES

Drastically Reduced from 10 to 50% Nationally Advertised Brands

813 ..... **$6.95 ea.** 807 ..... **$1.79 ea.**

Type	Net Price	Type	Net Price	Type	Net Price
1A4P	$0.24	6R7	$0.24	38	$0.24
1A6	.19	6SF5GT	.24	39/44	.24
1B6/25S	.24	6ST6	.39	45	.39
1B8z	2.29	6SF7	.39	50	.39
1B29	.39	6SJ7	.69	57	.24
1B32-632A	2.29	6T7G	.39	76	.24
1C6	.19	6U7G	.29	77	.24
1C7G	.19	6Z7G	.39	211 Vt4L	.29
1D6GP	.24	6ZY5G	.29	310A	.34
1D7G	.19	7C4 1203A	.24	371B	.34
1F4	.24	7E6 1201	.39	700A	7.95
1F5G	.24	10Y/VT25A	.19	703A	1.49
1H4G	.24	12A6	.34	705A	.79
1J6G	.24	12A6GT	.34	714AY	5.95
1J6GT	.24	12A7	.34	724B	4.95
1V	.24	12A7	.34	801A	.39
2A6	.39	12A8GT	.19	829	6.95
2A7	.24	12F5GT	.29	832	4.95
2C26A	.19	12H6	.29	837	1.49
2V3G	.49	12J5GT	.24	841	.29
2X2/879	.39	12J7GT	.24	864	.29
3FP7	.98	12Q7GT	.24	872A	.98
4AP10	.98	12SF5	.24	954	.19
5BP4	2.95	12SF5GT	.24	955	.34
5CP1	2.95	12SN7GT	.89	957	.34
5D21	19.95	12Z3	.29	1625	.29
5FP7	.95	16R	.19	1626	.24
5J23	5.95	19	.59	2050	.89
5T4	.49	2J22	1.95	2051	.49
6AB7	.59	28D7	.34	9002	.34
6AJ5	.89	30SPEC (Vt67)	.59	9003	.39
6B8	.59			9006	.29
6C4	.39	30	.24	GL4A21	.29
6D8G	.59	304TL	1.29	Amperite	
6F6GT	.39	32L7GT	.39	10T1	.29
6F6G	.59	33	.24	Jan	
6H6	.39	34	.24	CRP72	.98
6J7GT	.39	36, 81	.24	REL36	.69
6L6G	.39	36	.24	VR105	.89
6L7G	.39	37	.24	VR150	.49

WRITE FOR QUANTITY PRICES

SURPRISE PACKAGE
20 lbs. Ass't radio parts. A $25.00 value for only **$1.95**

Headphone Receivers ANBH1
Low impedance, used—good condition ..... **39c ea.**

COMMAND (SCR 274 N) EQUIPMENT

	Used	New
BC-453	**$12.95**	
BC-454	**5.95**	
BC-455	**7.95**	**9.95**
BC-456		**2.95**
BC-457	**5.95**	
BC-458	**5.95**	**8.95**
BC-696 (or T19)	**14.95**	**24.95**
BC-450—3 Receiver Remote Control	**.89**	**1.95**
BC-442		**2.95**
3 Receiver Rack	**1.95**	
2 Transmitter Rack	**1.50**	

Complete Command set as removed from aircraft—3 receivers—2 transmitters—Relay unit—control boxes—mounting racks—plugs—modulator and dynamotors—crated Set **$34.50**

MONTHLY SPECIALS

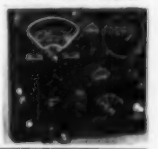
BC 456 Modulator of 274 N Command Equipment. Used condition as they come ..... **98c ea.** 2 for **$1.69**
NOTE: The overwhelming majority of these units is in A-1 excellent condition, with tubes.

RT7/APN1 TRANSCEIVER UNIT—Used as an altimeter, it may be converted for signaling control circuits, citizens band, etc. Complete with 14 tubes and dynamotor they are in good used condition at the amazingly low price of **$4.95**

SEND FOR FREE 8-PAGE ILLUSTRATED BULLETIN
listing many exceptional values

ARROW SALES, Inc.
Dept. M
1712-14 S. Michigan Ave., Chicago 16, Ill.
PHONE: HArrison 7-9374

BC 434 COMPASS CONTROL BOX



Contains 0-5 mil meter suitable for "S" meter—pots, knobs, crank, jacks, switches, five grain of wheat bulbs and numerous other parts. Like new at only **$1.29**

CONDENSERS

	Each
2 mfd. 4000 VDC. OIL FILLED	**$2.95**
1 mfd. 6000 VDC. OIL FILLED	**1.98**
.25 mfd. 15000 VDC. OIL FILLED	**4.95**
.00025 mfd. 25000 VDC. OIL FILLED	**2.95**
.4 mfd. 1500 VDC. OIL FILLED	**.29**
10 for	**2.49**
2 mfd. 600 VDC. OIL FILLED	**.39**
3 for	**1.00**
1 mfd. 600 VDC. OIL FILLED	**.24**
5 for	**1.00**
1-1-1—1200 VDC. OIL FILLED	**.59**
2 for	**1.00**
50 mmfd—5KV—5 Amp. Vacuum Cond.	**1.19**

18-185 Weston Voltmeter Model 433—0 to 150 VAC 25 to 2400 cycles. New **$24.95**

AS-138/ARN—10 inch streamline loop as used with direction finding receivers. Fixed position, it is ideal for planes, boats, automobiles. New **$2.95**

BC 906—Frequency Meter

Range 150-225 MC with modification possible for lower frequencies of TV, etc. Contains 0-500 DC microammeter and uses Battery pack of 1.5 V and 45 VDC.
Like New—Less Batteries **$12.95**

FLAP PITCH MOTOR

24 VDC. will operate on AC—11,000 R.P.M. Complete with gear box and limit switches ..... ea. **$2.95**

SOLENOID 110V60cyc. coil complete with trip arms that really snap into place and hold. New **49c**

BC-605 Interphone Amplifier

Easily converted to an ideal intercommunication set for office—home—or factory.

Original—New **$4.95**
Like New **3.95**
(With Schematic)

See April 1950 Radio News for complete conversion data.

BC-604 Transmitter FM 20-28 MC

11 and 15 meters. Can be operated on 10 meters—10 channel push button crystal. With all tubes and meter but less dynamotor. Excellent Condition **$14.95**
Crystals—Set of 60 ..... **14.95**

BC 603

Receiver—Good. Used **$24.95**

BC 620

Receiver-Transmitter—2 crystal channels—20 to 27.8 MC FM—13 tubes. Metered. Plate and Filament
New **$14.95**
Used **9.95**

PE 97 Power Supply for above 6-12 volt vibrator type.
Used less tubes, vib. & con. **$2.95**
FT 250 Mount for both BC 620 and PE 97 New **$1.50**

BC 223

Brand new Transmitter with all three tuning units, two tuning unit cases, spare tube carrying case, shock mount and brace, but less tubes at new low price of **$19.95**
Set of 5 tubes **$3.95**
Tuning units are available separately at Ea. **$2.50**
PE 125—12-volt Vibrator Pack ..... New **$12.95** Used **8.95**
Spare parts kit for PE 125 containing 2 tubes, 2 vibrators and 13 fuses in metal container with handle and clasp (8X 41) ..... New **$2.95**

All shipments FOB warehouse. 20% Deposit required on all orders. Minimum order accepted—$5.00. Illinois residents, please add regular sales tax to your remittance.

tems, frequencies and rules for each service, and the proper procedures to be followed in filling out the license application forms. The next three chapters are devoted to the matter of selecting the correct equipment for the system chosen and gives specifications on all of the mobile equipment currently available. Antennas and towers receive particular attention in two chapters devoted to this subject. A particularly valuable chapter on maintenance should prove a boon to the technician. A section on operator licenses and another on general FM theory round out this text.

We believe that persons in the mobile radio field would be doing themselves a great service to investigate this handbook as it will provide most of the answers needed in the day-to-day operation of two-way mobile equipment.

* * *

"FREQUENCY MODULATION" by K. R. Sturley. Published by *The Chemical Publishing Co., Inc.*, Brooklyn. 94 pages. Price $4.75.

Although presented in concise form, this text covering FM radio manages to convey an amazing amount of information on the subject. Designed for the radio technician, the author outlines the principles of frequency and phase modulation systems, the advantages and disadvantages of such systems over amplitude modulation, the modulating methods, and the various details of the FM receiver in simple terms.

The book is divided into seven main sections covering the general nature of the system, the advantages and disadvantages of FM and PM transmission, methods of modulating the frequency or phase of a carrier, the FM receiver, frequency to amplitude conversion, and a discussion of the complete receiver.

Treatment of the subject matter is largely mathematical and the student should have a working knowledge of college algebra and calculus for a complete understanding of the text. The book is well illustrated with charts and diagrams while a complete schematic of a typical FM receiver is included in the appendix. A fairly comprehensive bibliography on the subject of FM further enhances the text material.

* * *

"MOST-OFTEN-NEEDED 1950 RADIO DIAGRAMS AND SERVICING INFORMATION" compiled by M. N. Beitman. Published by *Supreme Publications*, Chicago. 192 pages. Price $2.50.

This is the tenth volume of this popular servicing series to appear and covers AM and FM combinations, straight receivers, and record changers produced during the past year.

Sets diagrammed include those of almost thirty manufacturers. In addition to a complete schematic on each of the receivers there is information on the correct alignment procedure, dial stringing data, trimmer locations,

as well as a concise step-by-step procedure for correct alignment.

A representative assortment of auto radios has also been included which, along with the record changer data, makes this book of particular interest to the technician.

• • •

"BETTER TV RECEPTION IN FRINGE AND LOW-SIGNAL AREAS" by Woodrow Smith & R. L. Dawley. Published by *Editors and Engineers Limited*, Santa Barbara, California. 137 pages. Price $2.50. Paper.

This is a thoroughly practical handbook for the installation technician. The text is written in easily understood language and is lavishly illustrated with photographs and line drawings.

The book is divided into six chapters. The first chapter, How the TV Signal Gets to the Receiver, covers fringe area reception, the space wave, the effect of irregular terrain, antenna height considerations, atmospheric effects, tropospheric propagation, absorption and scattering, antenna efficiency, elevation angle determination, horizon signal source, feed line matching, and proper viewing conditions. The second chapter deals with the various things the installation technician can do to improve television reception such as, field strength surveys, the use of field strength meters, a study of various signal deviations, the elimination of ghosts and fading, the use of boosters, and the adjustments which can be made to the receiver itself to improve sensitivity and increase the apparent signal strength.

The third chapter deals with the various types of television receiving antennas, their characteristics and applications. The fourth chapter discusses transmission lines and distribution systems while the fifth section covers the antenna, mast, and feed line installations. The final chapter is devoted to an analysis of the various types of interference and the steps which can be taken to eliminate or alleviate the condition.

All-in-all we believe that the alert technician operating in TV fringe areas will find this book extremely practical and a valuable addition to his kit of working "tools." —30—

"Last week $24.95 for rectifier tubes. This week $24.50 for a hat. Any questions?"

MARS Station of the Month

MARS BEAMS WEEKLY BROADCASTS

MARS—Army Headquarters station, WAR, located at the Pentagon Building, Washington, D. C., broadcasts a weekly message each Tuesday at 0100Z and at 0400Z. (This is Monday at 8 p.m. and 11 p.m., Eastern Standard Time; Monday at 7 p.m. and 10 p.m., Central Standard Time; Monday at 6 p.m. and 9 p.m., Mountain Standard Time; and Monday at 5 p.m. and 8 p.m., Pacific Standard Time.)

Simultaneous broadcasts are made on frequencies 3497.5 kc., 6997.5 kc., 14,405 kc., and 20,994 kc. Each message is sent three times, once at 10 words per minute, once at 15 words per minute, and once at a higher rate of speed—usually 20 words per minute.

Designed especially to transmit quasi-official traffic and training information to MARS members, the broadcast offers an excellent opportunity to all amateurs in building up their code proficiency.

THE history of ham radio is studded with the adventures and exploits of operators who figuratively eat, sleep, and drink amateur radio.

One such operator is Merrill D. Beam of Fort Monmouth, New Jersey, whose amateur station, A2BX (K2BX) has been named MARS Station of the Month by Captain E. L. Nielsen, Chief, MARS—Army.

Beam is a ham's ham. Not only is he active in MARS—Army nets (net control station on MARS New Jersey Sub-Net ZED), but he also is active in MARS—Air Force, checks regularly into ARRL traffic nets, and still finds time to lend a helping hand to amateur newcomers with code practice, procedure, or theory problems.

Beam, now Chief of the Maintenance Branch, Radar Engineering, Squier Labs, Fort Monmouth, has been active in the radio field since, at the age of 11, and using a spark-gap transmitter from his home in Johnson City, New York, he made his first contact with a neighbor, Wallace Dunmore, three miles away. There were no assigned calls in those days, operator initials serving as identification.

His first call was 8BFO; subsequently, Beam has held 2AGX, 2NB, NV2NB, 3PR, W3PR, 3XB, and his present call K2BX.

Biggest thrill in public service for Beam came in 1928 when the dirigible "Italia," captained by the famous Italian explorer, General Umberto Nobile, cracked suddenly into the ice about 650 miles from the North Pole and spilled the General and eight crew members out onto the ice. Six other crewmen were still aboard as the ship bounced back into the air and disappeared. They were never heard from again. Luckily, an emergency radio had been thrown clear. The marooned group patched up the set as best they could and put out a feeble "SOS"

Merrill D. Beam, A2BX/K2BX, of Fort Monmouth, New Jersey—a "ham's ham."

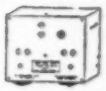
RADIOMEN'S HEADQUARTERS ★★ WORLD WIDE MAIL ORDER SERVICE!!!

TWIN COAXIAL CABLE
at a Sensational Price

Two No. 12 stranded conductors within a copper shield, vinyl jacketed, polythylene core, can handle over 5 KW. of R.F. power. The ideal TV leadin for the most exacting installations such as apartment house antenna systems. Perfect for any twinlead use calling for cable within the range of 70 to 95 ohm nominal impedance. Regular price 7.2c per ft. Your cost **$15.00** per hundred feet. Ask for RG-37U.

RG-59U 73 Ohm Coax. The most popular TV type. Regular price 17c per ft. Your cost 7c per ft. or **$6.50** per C.

SIGNAL CORPS INTERCONNECTOR RELAY BOX 730A



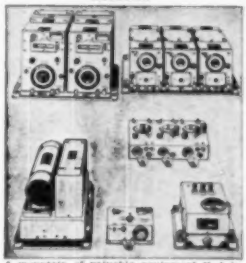
This valuable unit, made by Bell, and more familiarly known by the U. S. Army designation BC-616, is encased in a highly polished aluminum case 6½"x5½"x2½", and contains 150 mfd. of condenser capacity, sensitive relays, resistors, and terminal strips. Order several at the give-away price of only..... **$1.95**

SUPER SPECIAL

FAIRCHILD bombsight **POWER UNITS.** Brand new, contains 9 tubes with a value of **$15.00.** 8 electric motors or generators, 6 of the permanent magnet field type; relays, and 20 valuable precision resistors plus a multitude of the ordinary kind, in addition to many condensers and potentiometers. All for only..... **$14.95**

YOU PAYS YOUR MONEY YOU TAKES YOUR CHOICE!

SCR-274 COMMAND SET . . . THE GREATEST RADIO VALUE IN HISTORY



A mountain of valuable equipment that includes not 1 but 3 of the hottest superhet Communication Receivers, the famous BC-453, BC-454 and BC-455, each with tuned R.F. stage, 3 gang condenser, crystal, and 9 working tubes not counting rectifiers. Included are 2 Tuning Control Boxes; 1 Antenna Coupling Box with R.F. meter to measure power into antenna; 4—28V dynamotors (alteration of set to 110V operation is quick and simple); 2—40 watt transmitters including crystals; and pre-amplifier and modulator so transmitters can be used for voice or code. 29 tubes supplied in all. Guaranteed electrical condition. A super value at **$139.95.**

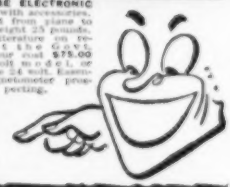
MICROPHONES

Super Special—Highest quality all chrome nickel-plated CRYSTAL MIKE of 1st-flight nationally-known brand— **$5.95.** Bullet DYNAMIC MIKE.. **$7.95**
T-32 MIKE with desk or table stand..... **$2.99**
MIKE *Jr.*..... **99c**

SOS EMERGENCY TRANSMITTER SOS

This is the famous Gibson Girl Transmitter that saved so many lives during the war. It is used as a distress call transmitter on boats and airplanes. The Gibson Girl is the easiest transmitter in the world to operate. No instruction or experience necessary. No external power supply required for operation. It is merely necessary to turn the crank on the top of the transmitter and power is generated and the distress signal is automatically sent out on the international distress frequency. Brand new Gibson Girl transmitter complete with tubes..... **$9.95**

BRAND NEW 14 TUBE ELECTRONIC ALTIMETER, complete with accessories. Shows absolute height from plane to terrain below. Total weight 25 pounds. Descriptive literature on request. Cost the Govt. $1,000.00, your cost **$75.00** for the 12 volt model, or **$45.00** for the 24 volt. Essential for magnetometer prospecting.



ANTENNA KIT

For Gibson Girl transmitter, 300 ft. antenna wire, 2 balloons, 2 kites, generators, box kite for windy weather, searchlight. Complete kit..... **$9.95**

CO-AXIAL CONNECTORS

Army No. PL 259 or Amphenol 83-1SP
Army No. SO 239 or 83-1R
Army No. PL 258 or 83-1J
Army No. M 359 or 83-1AP
49c each—in lots of 10 assorted, 39c each

1000 CYCLE AUDIO FILTERS

Navy PD52010-I low pass audio filters as mentioned in the "Praised Audio" article in June CQ, and designated by the above number, are the exact electrical and physical equivalent of commercial audio filter units selling for $25.00 each. They are infinitely better than the surplus "Radio Range Filters" being sold for reducing QRM, and at 2 KC of resonance for CW ample. A 2 section filter using PD52010-I is capable of twice the selectivity available through the use of the QR-er (the BC-453 section of the 274N) which has provided the amateurs' previous highest standard of interference elimination). **EXTRA SPECIAL—NAVY PD52010-I** with diagram..... **$2.00**

AC-DC POCKET TESTER

This analyzer featuring a sensitive repulsion type meter housed in a bakelite case, represents the culmination of 15 years' achievement in the instrument field by a large company specializing in electronic test equipment. Specifications of the AC-DC Model Volt-Ohmmilliammeter: 7 AC Volts—5-25, 50, 125, 250, DC Volts—0-25, 50, 125, 250. Milliamperes AC—0 to 50. DC Milliamperes — 0 to 50. Ohms Full Scale—100,000. Ohms Center Scale — 2400. Capacity — .05 to 15 Mfd. Total Price, prepaid anywhere in the USA..... **$7.00**

Phonograph Scratch Eliminator

Consists of 2 condensers and powdered iron core choke connected in a filter network. Same is used in most high fidelity sets to improve low tone response and eliminate scratch. Connects instantly between pick-up and amplifier. A super bargain at..... **$2.00**

AUDIO AMPLIFIER

Brand new dual stage triode amplifier having 2 of the valuable and scarce ounce type audio transformers that sell for over $10.00 apiece. Neat aluminum case, fully enclosed (largest dimension 6 inches). Perfect for intercom system, phono amplifier, mike amplifier or signal tracer amplifier for testing radio sets. A sensational bargain at only $3.40 each.

HURRY

Get your 2 gang midget superhet tuning condensers with ¼" shaft and trimmers. Reg. $1.25 each, now 5 for..... **$2.00**

NO FOOLING

A real professional serviceman's tube analyzer that makes it possible to check the life expectancy of a tube. The new, different, oversized 1950 Model Dynamic Mutual Conductance Tube Tester checks all tubes for gas, microphonics, hum, emission, shorts and mutual conductance performance. Detects more weak tubes. Checks filaments in sockets. Completely new switching arrangement that is really foolproof and trouble free. Imagine the satisfaction of a tube tester with a dynamic sounding ability to instantly test future tubes or tube types not listed on the built-in roll chart. No other tester can make such a claim!!! Portable Model **$68.50;** Counter Model **$64.50.**

POWER RHEOSTAT

Exceptionally Rugged. Trouble-free design. Withstands severe overloads up to three times their nominal 25 watt rating without burning or smoking. Perfect for voltage control or line voltage adjustment. 3 sizes available: 50 ohms, 2 amps. Special..... **$1.00**
$3.20. Special..... **$2.00**

$12.95 TAKES ALL THREE BIG BARGAINS

1. SENSATIONAL, FASCINATING, MYSTERIOUS SELSYNS made by the G. E. Company. Two or more connected together will work perfectly on 110V AC. Any number of the shaft of one Selsyn and all others connected to it will rotate exactly as many degrees. Ideal for operations from a distance, complete with diagram and instructions. Matched pair **$4.95. 2. ALUMINUM GEAR BOX** 18-to-1 that combines two powerful electric motors and two matched gear boxes, 32 gears in all, to give from 1¼ to 4 inches in diameter. This unit is readily converted to rotate a beam antenna or for any other similar use. **$5.00. 3. HOME WORKSHOP AT BARGAIN PRICE.** Accurate and precise 3 point guaranteed hobby lathe, the essential machine for the home workshop. Sturdy enough for light production work or factory steady service. Supplied with 56" of belting for connecting to any available electric motor or power take-off. Included in this unbelievable offer are such accessories as a ½" drill chuck with specially hardened tool steel jaws, a 4" electric furnace, high speed grinding wheel, x cotton buffing wheel with a large supply of buffing compound, and a 4" steel wire scratch brush. Your cost **$6.00.** Book expert agent. Distributor inquiries invited.

CYBERNETICS!

RT1463 12 Stage Electronic Brain containing 3—7F7, 1—7Y4, 3—7N7, 4 potentiometers, numerous resistors, filter and bypass condensers, filter chokes, power and audio transformers, and six sensitive plate relays. A military development that provided amazing degrees of control proportional to correction required, in the original application. This phenomenal unit, with its 3 multistage push-pull amplifiers and six 5,000 ohm relays in bridge circuits, will accurately control any 3 operations, related or unrelated, in minutely adjustable uniquely quantitative variations in either forward or reverse directions. 9"x7"x8" black cradle aluminum case. Brand new in original carton..... **$9.95**

MOTOR DRIVEN
Bandswitching Tuning Turret

4 bands above 100 Mc. 214 silver plated coil wire. Tuning condensers, driving motor diagram included. Only..... **$2.95**

STROMBERG CARLSON

Power Switching Relay Box. Neat 3"x4"x3½" metal case with tight sliding cover. Beautiful crackle finish..... **$0.98**

Eliminate the danger of fatal shock. Use our G.E. Interlock Safety Switches priced at only $1.00 each.

"DRILLMASTER" ELECTRIC DRILL

Pistol grip electric drill, ideal for hobbyists. Complete with sander, buffers, grinding wheels, etc. **$9.95**

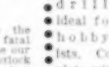
NEW G.E. TRANSMITTER

Brand new General Electric BC-375 or BC-191 transmitters, export type, complete set of spare tubes as well as 10 and 20 meter conversion instructions **$100.00**
BC-312, BC-348 or BC-224 receivers sold with the above transmitters, unit for unit, 1000-mile range..... **$125.00**

Universal 4 lead broadcast band oscillator coil can be converted to 3 lead type by addition of jumpers. Ten for..... **$1.00**

SENSATIONAL BUY

RT-1711 Brand New 12 Tube, 110 Volt Receiver-Indicator-Oscilloscope complete with all tubes and power supply. Govt. APA1 Radar Set. Scope tube is equipped with a detachable calibrated screen..... **$39.95**



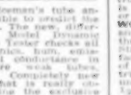
3-Gang Broadcast Band Permeability tuner. Was $2.50. Now $1.50.

REMOTE CONTROL UNIT

Aluminum case 4x3x2 containing 2 potentiometers, triple pole switch, 4 knobs, phone jack, rear barrier terminals and revolution counter..... **99c**
With 8 prong JAN connector to fit box..... **$1.39**

SPECIAL

50 MMF. 24 plate variable cond., 29c or 5 for 99c



Bayonet type radio pilot light sockets, $5.00 a hundred. Mazda Incensed bulbs, per 10..... 500

ACRO TELEVISION CHASSIS CRADLE

Pays for itself in a week—Saves and eliminates broken tubes, nuts, dials, etc. Cadmium plated steel, finger-tip control. A necessity for Television Service. Your Cost..... **$4.69**

BUFFALO RADIO SUPPLY, 219-221 Genesee St., Dept. RT-10, BUFFALO 3, N.Y.

which was picked up by Beam who was tuning through the amateur bands in New York. He sounded the alarm to the newspapers and soon workers from the Spitzbergen rear base effected the rescue.

Other highlights of his amateur career include experimental work (W3XB) with Professor Picard, Dr. Kendrick of Tufts College, and Dr. Woodruff of Pennsylvania State College on Kennelly-Heaviside Layer fading, handling all traffic for the Philadelphia-Pittsburgh area for Admiral Byrd's first antarctic expedition, and earning ARRL awards.

Beam's engineering background includes affiliation with *Western Electric* and *Vitaphone Corporation*, work with *International Business Machines Corporation, Bell Telephone Company*, and stints as Chief Engineer with broadcast stations WIAD, WELK, WCAU, WHP, and WSYR.

During World War II Beam was assigned first with the Office of the Chief Signal Officer in Washington, D. C., and later as head of the Fifth Army Forward Team, rebuilding captured enemy radio stations and putting them on the air for jamming and/or propaganda (psychological warfare) purposes.

—30—

DANGER!

By H. LEEPER

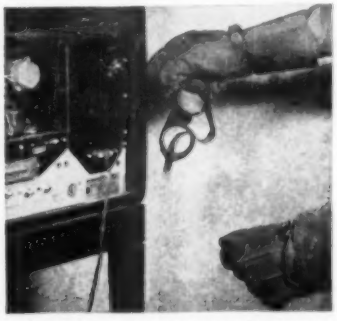
ALTHOUGH much has been said and written about the dangers involved in the careless handling of television picture tubes there are still many technicians who are ignoring the most elementary safety precautions when working on these units.

The danger from implosion during the installation or removal of the tube is ever present and the cautious service technician will wear heavy leather gloves and protect his eyes with specially-designed goggles when handling these tubes.

The habit of donning gloves and goggles is an easy one to acquire, takes little time or trouble, and can possibly save an eye or even a life! Start developing this habit today.

—30—

The importance of wearing goggles and heavy leather gloves when installing a television picture tube cannot be over-stressed. The danger from implosion is ever-present.



NOVEMBER

GREATEST AUDIO ISSUE OF *All Time!*

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International Short-Wave

(Continued from page 61)

Organization European de Radiodiffusion; this group is taking over the oid U.I.R. and will operate the Control Center in the future; also publishes a monthly bulletin with information concerning new stations and other data."

* * *

Identification

Here are some interesting identification announcements to help identify Arabic-speaking outlets, as compiled by Herbert Bluman, Tel Aviv, Israel, for *Nattugglan*, Sweden:

Limassol, Cyprus—"Mehattat esh-Shark el adna l'il iza'at il-arabiya." *Damascus, Syria*—"Houna Damash." *Beirut, Lebanon*—"Mehattat el' iza-'a il-Lubaniya, Beyrout." *Baghdad I, Iraq*—"Hatheehee Barr-da'd" ("gh" in Baghdad pronounced like a guttural "r"). *Mecca* (or *Djeddah*), *Saudi-Arabia*—"Il iza'a l'il ezza-kiyah l'il-mamlakat es-Saudiya." *Sanaa, Yemen*—"Houna San'a." *Cairo, Egypt*—"Il Kehira." *Tel Aviv, Israel*—"Mehattat Isra'il." *Algiers, Algeria*—"Al-Jeza'er." *Rasmallah, Trans-Jordan*—"Houna il Kuds, il eza'a il Urduniya-Hashemiya." *Tangiers, Morocco*—"Houna Tanj'r." *Omdurman, Anglo-Egyptian Sudan*—"Houna Omdurman." Other stations—*BBC, London*, "Londra;" *Paris*, "Houna Baris;" *Moscow*, "Houna Moskov;" *Teheran*, "Teh-rn;" *India*, "Delhi;" *Indonesia*, "Houna Jakarta."

* * *

"Op-Aid" Available

"OP-AID," recently published by the *Amalgamated Short Wave Press, Ltd.*, London, as successor to the *Short-Wave Listeners' Annual*, is now available in the United States, for 30 cents, postpaid, direct from Anson Boice, 28 Eisenhower Drive, New Britain, Connecticut.

Topics covered by "OP-AID" include prefixes; block allocations; amateur prefixes, alphabetical; amateur prefixes by country; call areas; radio zone boundaries; local time conversion *(GMT)*; mileage table (from London); QSL bureaus of the world; international "Q" code; amateur codes; International Morse Code; states and zones charts; maps of USA and USSR call areas, and other pertinent information.

* * *

"World Radio Calls"

From Arthur Cushen, New Zealand, comes this word—"'*World Radio Calls*,' 1950 Edition (48 pages) of the callbook of the *New Zealand Radio DX League*, is now available. The book is handy size—8½x5½ inches—has a complete list of every known broadcasting station in the world (*except* in the case of South America where, due to shortage of space, only those above 1 kw. in power were listed in the BCB section); the log covers New Zealand, Australia, South Pacific, Asia, Africa and Middle East, Europe,

North America, South America, in the BCB; on s.w. has complete list of all stations, powers, schedules, slogans, et cetera, from 2.240 to 26.100; the North American BCB section lists calls, location, power, and zone, and is well set out with space for additions on each frequency. The book has a striking two-color cover, details on the DX hobby, and so on.

"Price is 2/3 or 35 cents, postpaid, and can be had from the *New Zealand Radio DX League*, 15, Plunket Street, Dunedine S. 2, New Zealand (or from our North American Representative, Don Trelford, % Dept. of Lands & Forests, Foleyet, Ontario, Canada); if orders are mailed direct to New Zealand, please send seven 5-cent stamps. Don will airmail the orders to us from Canada and so speed delivery."

* * *

This Month's Schedules

Argentina—Buenos Aires noted recently in the 19-m. band, varying 15.210-15.250; seemed to be relaying LR4, "Radio Splendid," at times announcing also "Radio del Estado" and "Radio Red Argentine" (Argentine Network); strong signal in N.C. 1720-1800. (Ferguson). Also reported by Oskay, N. J., on such varying (measured) channels as 15.2166, 15.234, 15.2236. *Radio Sweden* reports this outlet at 1500-1800; says *Radio El Mundo* is currently heard in Sweden on 6.180, around 1800.

Australia—*Radio Australia* has effected these changes—To British Isles, 0155-0315, VLB3, 11.76, replaced VLB4, 11.85; at 1500-1800, VLA8, 11.76, replaced VLA4, 11.85; at 0900-1000 is now using VLB6, 15.200. To Africa now 1015-1115 over VLB9, 9.58. The French program 0245-0345 now is on VLG11, 15.21, replacing VLG10, 11.76.

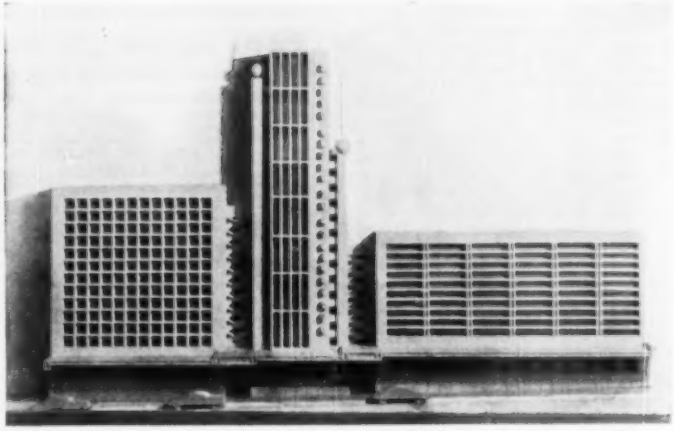
Austria—*Blue Danube Network*, 9.617, Salzburg, sent QSL card and listed schedule as Sunday 0100-1800, weekdays 0000-1800; news Sundays 0200, 0400, 0600, 1300, 1500, 1755; daily news 0030, 0115, 0400, 0600, 0800, 1000, 1215, 1655, 1755. (Pearce, England)

Belgian Congo—OTM, 9.400 and 6.295, has news in French 0000-0009, followed by music. (Bellington, N. Y.)

Brazil—ZYC9, 15.370, Rio de Janeiro, "*Radio Tupi*" noted 1645 with poor signal, bad CWQRM. (Saylor, Va.) ZYB9, 15.156, Sao Paulo, noted with good level to 2130 sign-off. (Russell, Calif.) Sao Paulo on approximately 9.605 seems to relay *Radio Record*, 1000 kc.; signs off 2300 with gongs. (Stark, Texas) *Radio Sweden* reports *Radio Record* on 6.040 after 1800.

ZYN7, 15.165, Fortaleza, noted 1400 with American recordings. Also noted signing off 1500. (Leary, Ind.)

Canada—Schedules for the *International Service*, at the time this was compiled, were—*European Service*—0915-1130, CKNC, CKCX; 1130-1545, CKNC, CKCS; 1545-1600, CKCS; 1600-1830, CKCS, CHOL. *Australasian Service*—2250-2320, commentaries from the UN (*except* Sat., Sun.), CKLX, CHOL; Sunday *only*, *English* for Southwest Pacific Area, 0340-0530,



Model of the new studios being built for Lourenco Marques Radio and Radio Club of Mozambique at Lourenco Marques, capital of Mozambique, Port. East Africa.

CHOL, CKLO. *Caribbean and Latin American Service*—1850-2145, CKRA, CKCX; 2145-2235, CKRA, CKCS. Channels are CKNC, 17.82; CKCS, 15.32; CKCX, 15.19; CKLX, 15.09; CKRA, 11.76; CHOL, 11.72, and CKLO, 9.63.

Cape Verde Islands—CR4AA, 5.895, noted to 1700 sign-off. (Staples, England)

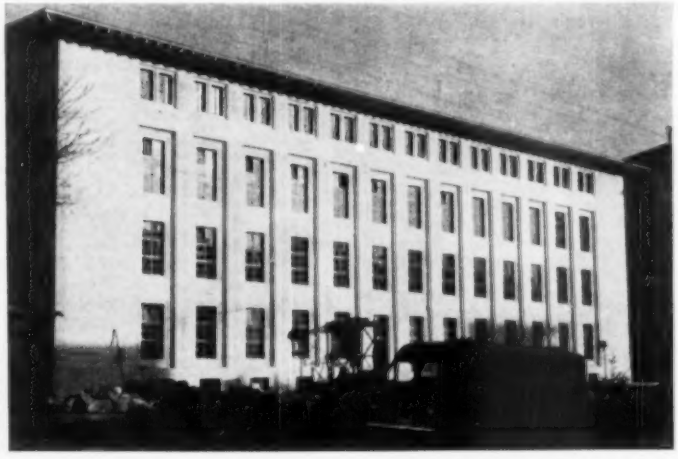
Chile—CE1190, approximately 11.898, noted leaving air 2315 with orchestra playing Elgar's "Land of Hope and Glory," followed by chimes playing the first six notes of that melody; also noted 1930. (Russell, Calif.)

China—At the time this was compiled, "*Radio Peking*" was announcing *only* 15.060 and 10.260; news 0830. Cushen, N. Z., received a verification from Peking which listed those channels and schedule of 0330-1030, reports *Radio Australia*. Bellington, N. Y., recently noted the 19-m. outlet (actually 15.054V) signing on 0330 with male chorus. In verifying for Cox, Dela., gave QRA as Peking Broadcasting Station, 3 St. Si-Chang-An, Peking, China. Oskay, N. J., recently measured the 19-m. channel as 15.0554 at 0620.

A Chinese outlet has been noted on measured 5.983 with music 0535. (Oskay, N. J.) Reported by Russell, Calif., at 0630 with music, and as Nanking.

Costa Rica—Rosenauer, Calif., received letter, QSL card, and schedule from TIFC, "*Lighthouse of the Caribbean*," P.O. Box 1307, San Jose, Costa Rica. Listed as the "Harry Strachar Memorial Station," operated by the Radio Voice of the Latin American Mission, Inc., Ridgefield Park, New Jersey; has TIFC, m.w., 995 kc., and TIFC, s.w., 9.645; m.w. transmitter is *RCA* DTA 1-L, output 1 kw.; s.w. transmitter is a homemade, temporary job, output 200 to 250 watts, using a

This is Turkey's second modern Broadcasting House. The building was completed late last year in Istanbul. The other was built in Ankara in 1938 where a new 100 kw. short-wave transmitter will soon go into regular broadcast service.



quad antenna; hours of operation are 1600-2400; programs in *English* include Sunday 1600-1700, 2300-2400, and Mon.-Sat. 2330-2400.

Cuba—COBL, listed 9.833V, Havana, *"Radio Cadena Suaritos,"* recently has been on 9.855, noted evenings. (Stark, Texas) Heard signing off 0002 with fair signal; relays CMBL, 850 kc., m.w. (Neeley, Ore.)

Curacao—PJC2, 5.010, Willemstad, heard 1950 with popular music; *English* announcement 2000, followed by *English* program, *"Holland Today and Tomorrow"*; left air 2130 with Dutch National Anthem; *this is Mondays.* (Cox, Dela.)

Denmark—OZH, 15.165, Copenhagen, noted 1130-1330 with Home Service; good signal but becomes noisy around 1300. (Saylor, Va.)

France—Paris now uses 6.145 in parallel with 6.200 for *English* beam to Britain 1345-1445. (Pearce, England)

French Cameroons—According to *Radio Sweden*, by this time Douala should have replaced the 600 watt 9.150 outlet with a *new* 1 kw. transmitter on 7.287, scheduled daily 1230-1530.

French Indo-China—Stark, Texas, hears the *"Voice of Viet Nam,"* 9.620, early mornings; Balbi, Calif., confirms has moved there from former 9.670, says should have news in French 0815, and in *English* 0830; parallels 7.265 which has poorer signal.

Hanoi, 6.190, noted early as 0830, signs off 1030. (Russell, Calif.)

"Radio France Asie," Saigon, advised Cushen, N. Z., would move from 11.840 to 11.830 to avoid interference from LRT and DUH5; however, it has been noted on 11.830 here in the USA ever since it began use of its "claimed" 11.840 outlet! Should be in clear after VLW3, Perth, W. Australia, signs off 0500, and should have news at that hour.

French Morocco—QRA for *Radio Maroc* is 15 Avenue du Congo, Rabat, French Morocco, Africa. (Patrick, England) *Radio Maroc*, 6.006, opens 0050 (some days not until

(*Continued on page* 136)

0100) with "La Marseillaise," followed by news in French. (Bellington, N. Y.)

French West Africa—Boice, Conn., has received verification from *Radio Dakar* confirming reception on 11.895; stated schedule on 208 m. and 11.895 is 0200-0300, 0700-0830, 1300-1800; on 15.340 at 1400-1600; *new* card shows map of Africa in yellow, French West Africa depicted in red, and Dakar

(*Continued on page* 158)

THE BC-454 "TWO-BANDED"

By EARL F. BRYANT, KH6ABE

THERE certainly is plenty of room for complaint concerning the very common BC-454 and ARC-5 equivalent receivers. "Cuss" 'em if you will but compare price tags with any other gear available—including surplus if time and trouble of conversion can be counted an economic factor—and the truth automatically "outs" that here is one set that has a place in every ham shack. The HRO-kilowatt boys use them as standby and portable gear while the forcibly budget-minded SWL's and beginning hams find that they can have a pretty considerable amount of receiver and still stay 'way over there on the safe side of ten bucks.

Very likely, most of the breed have been placed back out of the way in honor of the usual 80 meter summer fadeout—that's what happened at KH6ABE and KH6YI. This made for an ornery situation since both stations were 80 meter c. w. only rigs and it's no fun standing over in the line of silent keys. One afternoon while looking at one of the crude little devices—yes, looking—why listen?—the two of us suddenly realized that the maximum frequency available is just a little more than twice the minimum. That is, the calibration is from three to six megacycles plus perhaps five or six hundred kilocycles of "dark-space" at the ends of the dial. Now, slide the whole business so that minimum frequency becomes 3.5 mc. and the top becomes a very pretty 7.2 or 7.3 mc. So we dood it!

By the time-honored "cut-and-try" method (what's math anyway?) we determined that there are just exactly two turns too many on each of the coils to permit two-band operation (that's on the flat-wound coils, of course—no need to touch the pi-wound section). Realignment is best accomplished by putting a hefty in-the-band signal in at the antenna terminal, diddling the trimmers on the oscillator section of the main tuning condenser until the signal can be located by turning through the band, and then peaking the mixer section. Once put as near to proper alignment as this the whole range can be shifted up or down a little by manipulation of the oscillator trimmers. Both of the receivers we worked over in this manner wound up with a frequency range of 3.2 to 7.3 mc.

The local consensus is that a two-band BC-454 becomes quite worthy of such refinements as double conversion, noise-limiter, bandspreading—jobs that never got done before but have now been completed at KH6YI—li'l Earl is cautious enough to let the other guy work out the kinks on big additions but doesn't mind wielding a wicked pair of side-cutters for a worthy cause.

—30—

High Impedance Probes

(Continued from page 48)

observing the resulting fidelity of screen response.

Since R_1 and C_1 are unrestricted aside from the value of their product, the input impedance of the probe is under the designer's control. Practical limits are encountered, however, in the matter of signal attenuation.

The impedance ratio of the input circuit with and without the probe is under the control of the designer, and is approximately equal to R_1/R_2. Hence, if R_2 is 0.75 megohm, the input impedance can be raised ten times and frequency characteristics improved by making $R_1 = 7.5$ megohms.

The design rules to be observed are: Determine the input impedance desired, and make a choice of R_1 accordingly. Neglect the influence of a blocking condenser. Measure or estimate the value of C_2 and make $R_1C_1 = R_2C_2$, choosing a small variable condenser for C_1, such as a ceramic trimmer condenser.

After making up the probe, connect it to the scope input, and with a square-wave generator connected to the probe, vary C_1 until the best square-wave form is obtained on the screen. The probe is now ready for use in high-impedance test work.

Alert designers will note that these basic principles apply to many other situations besides probes, and will make use of them whenever they are designing circuits in which frequency compensation is a factor to be considered.

—30—

General Electric Company has recently announced a new transmitting tube, the GL-5680, which has been especially designed for use as a power amplifier in Coast Guard transmitters to aid long-range navigation. The tube is forced-air cooled and may be operated at maximum ratings at frequencies as high as 5 mc. In pulsed r.f. power amplifier service, the tube is capable of delivering a peak power output of 90,000 w. at 15,000 v. under typical operating conditions. It can also be used as an r.f. power amplifier and oscillator or as an a.f. power amplifier and modulator.

A RECEIVER DETUNING ALARM

By A. H. TAYLOR

This novel circuit can be used with both AM and FM receivers. A warning alarm will be sounded when receiver is improperly tuned.

FEW household users of receivers tune them accurately. They seem satisfied if they hit the edge of the sidebands, and if there is a tuning indicator they don't look at it.

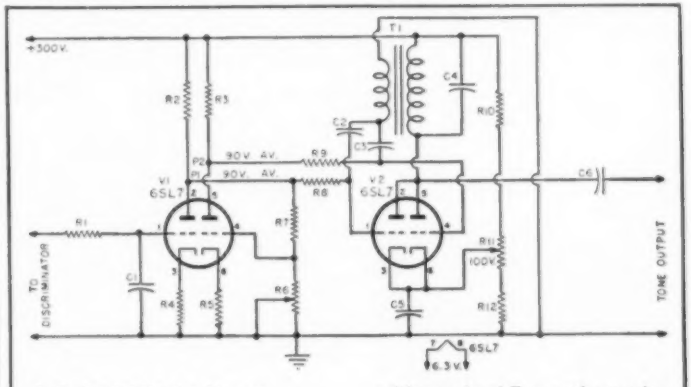
The circuit shown in Fig. 1 will compel them to tune accurately as an audible alarm will be sounded if the receiver drifts off center. It is most easily applied to an FM receiver, although it can be used with an AM receiver if a discriminator is provided as, for example, is done for a.f.c. It is controlled by the d.c. output of the discriminator and its tone output is coupled into the receiver audio system in any convenient manner.

In the diagram of Fig. 1, V_1 is a phase inverting d.c. amplifier and V_2 is the audio oscillator. When the discriminator d.c. output voltage is zero, *i.e.*, when the station is tuned in exactly or when there is no signal other than random noise, both plates of V_1 and, hence, both grids of V_2 are at the same d.c. potential which is enough below the cathode potential of V_2 to block both sides of the tube and prevent oscillation. A positive discriminator output unblocks one side and a negative discriminator output unblocks the other side so that in either case a tone is generated.

The values of the components used in the construction of this unit will depend largely on the tubes used. None of the component values is critical, however, except those of R_5, R_6, and R_7. If perfect phase inversion for equal sensitivity to detuning on either side of center is required, it may be necessary to make R_5 as well as R_6 variable to accommodate individual tubes. In general, however, proper choice of R_5 and adjustment of R_7 will serve to shut off the tone for no-signal or for center-tuned signal.

The alarm sensitivity, *i.e.*, the

Fig. 1. Circuit diagram. The tone oscillator is keyed by a d.c. signal from receiver.



R_1, R_2, R_3—500,000 ohm, ½ w. res.
R_4—4000 ohm, ½ w. res.
R_5—10,000 ohm, ½ w. res.
R_6—100,000 ohm pot. or rheostat
R_7—2.2 megohm, ½ w. res.
R_8, R_9—1 megohm, ½ w. res.
R_{10}—10,000 ohm, 5 w. res.
R_{11}—5000 ohm, 2 w. pot.
R_{12}—5000 ohm, 2 w. res.
C_1, C_2—.2 μfd., 500 v. oil-filled cond.
C_3—.05 μfd., 400 v. oil-filled cond.
C_4—.8 μfd., 600 v. oil-filled cond. (This value is used when the primary of T_1 equals 5 henrys and a 500 cycle note is desired. For a different value of T_1 or another tone frequency, the value of this condenser must be changed.)
C_5—5 μfd. (or higher), 150 v. elec. cond.
C_6—.05 μfd., 600 v. oil-filled cond.
T_1—Osc. trans. Inductance a few henrys, feedback ratio 1:3. Suitable units are tone osc. trans. from BC-456 or tapped line-to-speaker transformers. Windings must have proper relative polarity for oscillation
V_1—6SL7GT tube
V_2—6SL7GT or (with more bias) 6SN7GT tube

amount of detuning necessary to sound the alarm, is adjusted by varying V_2 bias with R_{11}.

Typical performance of the phase inverter is as follows: When balanced, the potential of both plates is 95 volts. A signal of plus 2 volts applied to the input of V_1 causes P_1 of V_1 to drop to about 50 volts while P_2 rises to 160 volts. A signal of minus 2 volts causes P_1 to rise to 160 volts and P_2 to drop to about 50 volts. Thus, the sensitivity is equal for detuning either way, the nonlinearity being of no consequence in this application. If this sensitivity is too great it can be reduced by applying only part of the discriminator d.c. output to V_1.

The d.c. phase inverter shown with V_2 is not theoretically stable with variation in plate supply voltage. However, the drop of plate supply voltage from 300 to 200 volts produced only a slight unbalance which was easily corrected by resetting R_5. Changing tubes had no effect.

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Picture Distortion

(*Continued from page 76*)

as shown in Fig. 2, we can delay the saw-tooth which is used for sync comparison with respect to the saw-tooth feeding the deflection yoke. The saw-tooth applied to the phase comparer circuit is represented by the voltage E_{ss}, and the saw-tooth used to feed the

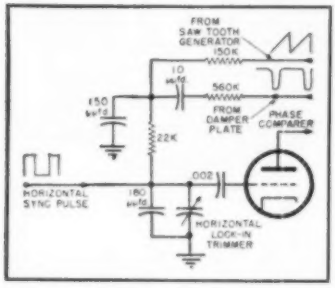

Fig. 4. Diagram of the phase comparer input circuit showing the delay network.

horizontal deflection coil is represented by the voltage E_{hs}.

We have now accomplished the task of speeding up, or advancing in phase, the deflection sweep in relation to the blanking pulse applied to the picture tube grid.

The actual circuit as used in production receivers is shown in Fig. 4. Here it shows that the shaping pulse from the damper plate is also fed through the delay network before it reaches the phase comparer in order to maintain the proper shape or slope of the saw-tooth used for phase comparison.

If it is desired to apply this circuit to other receivers, the values may vary from those shown.

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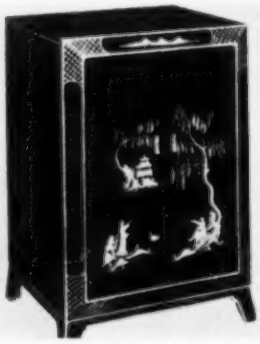
NEW 1951 TV RECEIVERS

"MANDARIN"

Of special interest to homemakers who have Chinese Chippendale or other Oriental-motif furniture is the "Mandarin," a 19" television console



recently introduced by *Sightmaster Corp.* of 20 West 35th Street, New York 16, N. Y.

The set is housed in a full-door, hand-painted Chinese design cabinet which is available in various color combinations.

"COSMOPOLITAN"

The Magnavox Company's newest TV receiver is the modern "Cosmopolitan" which is available in either white oak or mahogany finish.

This 16" set features the company's 12" magneto-dynamic speaker for three-dimensional realism.

The set, which includes a synchromatic chassis with 20 tubes, instant tuning, built-in antenna, and "Magna-Lok," is being manufactured at the company's Fort Wayne, Indiana, plant.

"THE CATALINA"

Olympic Radio & Television, Inc., 34-01 Thirty-Eighth Avenue, Long Island City, New York, recently introduced twelve new television receivers which make up the company's 1951 line.

"The Catalina," Model 766, is a

three-way console with a 16" rectangular picture tube. The combination includes, in addition to the video, an AM-FM radio and a three-speed record player.

The receiver is available in two finishes. The Model 766 has a mahogany cabinet while the Model 766B is in blonde finish.

STEWART-WARNER SETS

Ten new television models, ranging in size and type from a 14" table model to a 19" console with AM-FM radio comprise the *Stewart-Warner Corporation* line for 1951.

The "top of the line" is the Model

9122-A custom deluxe 19" console. This set provides 203 square inches of viewing area plus AM-FM radio reception. The cabinet is of authentic 18th Century English styling in dark Honduras mahogany.

The receiver uses 28 tubes plus 3 rectifiers, has a one-knob picture control, channel eye tuning, the "Miracle" turret tuner, and gated a.g.c.

The Model 9122-A is being manufactured at the company's plant at 1826 Diversey Parkway, Chicago 14, Illinois.

MOTOROLA SET

The Model 19K3, a 19" television console, is receiving special attention among the twenty-nine new models

being introduced by *Motorola, Inc.* of Chicago.

This new set is housed in one of the company's "Fashion Award" cabinets and is done in 18th Century styling in hand-rubbed mahogany.

In addition to its big 19" tube, the

set features target tuning, an improved power transformer for better fringe area operation, and "good neighbor" shielding, a recent development which reduces oscillator radiation which can cause interference in neighboring TV sets.

The console measures 39¼" x 28" x 22$^{25}/_{16}$".

19" TABLE MODEL

The newest addition to the *Starrett Television Corp.* line of 1951 television receivers is a 19" tube table model.

Features of this new set include a high efficiency horizontal output transformer, a super-power vertical output circuit (with extra tube), a phono-jack, and unitized controls.

The company is manufacturing this and other sets in its 1951 line at 601 West 26th Street, New York, N. Y.

"THE KENWOOD"

Among the television receivers introduced by *Stromberg-Carlson Company* of Rochester, New York, in its 1951 line is "The Kenwood," a 17" combination.

Designated the Model 17 RPM, this video-FM-AM-phono combination is housed in a hand-rubbed mahogany veneer cabinet of authentic Hepplewhite design. The set provides a 158 square inch screen on the 17" black glass picture tube.

The receiver features the company's long-life tuner, keyed a.g.c., and 6-to-1 gear reduction tuning for micro-accurate station or channel selection. It also incorporates a built-in antenna, a

12" PM speaker, as well as a three-speed record changer, and AM-FM radio. The set carries the *Underwriters' Laboratories* approval.

HALLICRAFTERS TV

The Hallicrafters Company of 4401 West Fifth Avenue, Chicago 24, Illinois, has announced twenty-two new television receivers in its 1951 line.

The "800 line" features a new dynamic tuner which uses a precision-printed circuit to obtain accuracy and sharpness of tuning, the "Silver Vortex" built-in antenna, a ventilated chassis, the use of a wider i.f. bandwidth, automatic contrast control and picture lock-in, high contrast black tubes, and a focalizer control which

projects through the back of the cabinet.

Among the units demonstrated to the company's distributors recently was the Model 890, a 20" rectangular tube combination console which fea-

tures radio and phonograph reception in addition to the video. The set is housed in a "Provincial" type cabinet which fits in with many different types of "informal" furniture styles.

HOFFMAN TV

The trend toward larger picture sizes is being carefully followed in the 1951 line of television receivers introduced by *Hoffman Radio Corporation* of Los Angeles.

One of the attractive models being presented by this West Coast firm is the 890, a 19" console housed in a blonde oak cabinet of modern design. The cabinet measures 38½" x 29½" x 21½" and is constructed of Eastern hardwoods with waxed finish.

The receiver features the company's "Easy-Vision" lens for visual comfort, the "Silver Circle" tuner circuit, dual i.f. stages for separate sound and video adjustment, electronic black-and-white for even brightness on all channels, and a tunable "In-Dor" antenna. The circuit uses 18 tubes plus 2 rectifiers in addition to the picture

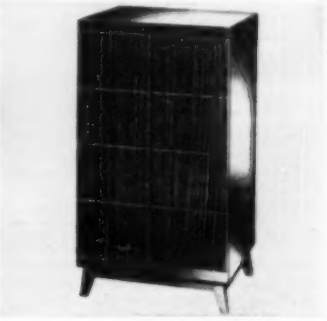
tube. A 12" speaker with increased bass response for tonal clarity has also been incorporated.

RCA'S 1951 LINE

One of the attractive, popularly priced television receivers in the 1951 line of receivers recently introduced

by *Radio Corporation of America* of Camden, New Jersey, has been named "The Modern."

This Model 6T75 is a full-door console on a swivel base which makes it



possible to face the set toward any part of the room. In this way furniture rearrangement is no longer required. The cabinet, which is available in walnut, mahogany, or limed oak finish, is of advanced modern design. The cabinet measures 41" x 23½" x 21".

The set has a 16" tube and incorporates the newly-developed *RCA* electronic circuits.

"The Modern" is only one of the 18 models which constitute the *RCA* '51 line.

RAYTHEON LINE

Raytheon Manufacturing Company's 1951 line of television receivers consists of twenty-one models ranging in size from 12½" to 20" units.

Sixteen of the receivers in the 1951 line are entirely new, with five of the most popular numbers in the Spring line being carried over. Three of the sets have 12½" tubes while eighteen units are equipped with 16" to 20" tubes.

The top of the line is a four-way console combination with a 20" picture tube, AM-FM radio, and an automatic phonograph which plays all record speeds. This set is housed in a mahogany Chippendale cabinet and has been designated "The Adams."

All of the receivers in the line feature the company's "Ray-Dial" con-

TURRET SOCKETS FOR UNIT-TYPE CONSTRUCTION

By RUFUS P. TURNER, K6AI

BREADBOARDS and lab-table hay-wire "lashups" have been used for years for the quick wiring and testing of experimental circuits. Both of these schemes leave much to be desired in safety, solidness, compactness, and stability. The new turret sockets, available in loctal, octal, and miniature sizes, now permit the experimenter to wire all normal components of a single stage rigidly to the associated tube socket. Soldering lugs are mounted around a bakelite "turret tube" rigidly fastened to the under side of the tube socket. Holes are provided at both top and bottom of this tube for passage of wires.

In addition to providing an efficient means for quickly assembling a complete circuit for testing, the turret socket allows the entire finished stage to be transferred as a compact unit to a main chassis simply by bolting the tube socket in place in the normal manner. The accompanying photographs show appearance of the turret socket and typical methods of using it.

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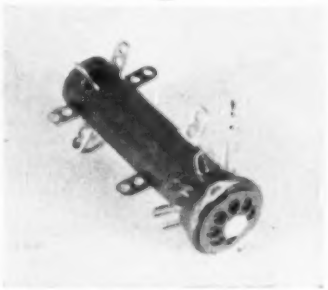
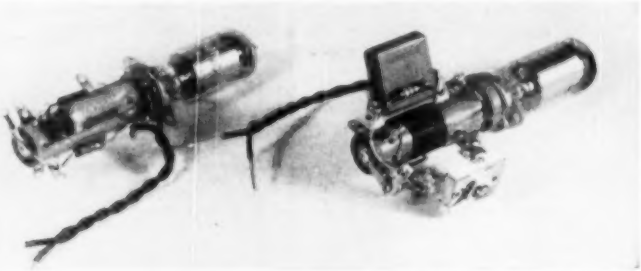


Fig. 1. Miniature turret socket ready for wiring. Pretinned lugs are mounted radially on the center bakelite turret tube.

Fig. 2. Two miniature turret sockets wired with complete electronic circuits, and with tubes plugged in. The left-hand assembly is a complete resistance-coupled amplifier stage. The right-hand arrangement is a complete oscillator circuit. Note that the oscillator coil is wound directly on the turret tube in this application.



tinuous tuner, single knob tuning, "Hi-Lite" picture power which provides high picture tube anode voltages, built-in antenna, a balanced magnetic speaker, full transformer operation of both heater and d.c. power circuits, and prefixed focus.

The *Raytheon* line is being manufactured at the *Belmont Radio Corporation Division's* plant in Chicago.

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Spot Radio News

(*Continued from page* 18)

convertibility, small area and inter-dot flicker . . . for securing purposes . . . *RCA* should be entitled to offsetting points under additional categories for electronic versus mechanical operation, no limitation of picture size and no limitation of viewing angle."

IN A CONTINUING EFFORT to prove the worthiness of their color system, *RCA* demonstrated over a coax-ultra high circuit between Washington, New York, Princeton, and Bridgeport, how signals could be transmitted effectively over a 200-mile wire line, relayed over a high-frequency radio link and eventually be rebroadcast on the ultra highs. Signals originating in the studios of WNBW, at the Wardman Park Hotel in Washington, were piped over a coaxial line to WNBT in New York, and from this point beamed to a receiving station at Princeton, about 45 miles from New York City. At this key point, the signals were fed to a relay circuit and aired to *NBC's* experimental ultra-high station at Bridgeport. At a site twelve miles away in the home of *NBC's* chief engineer, O. B. Hanson, the final signals were received on a converted v.h.f. color receiver.

A few days prior to this special test, appeared a report which also disclosed the progress which had been made at the receiving end of color. The text revealed that research work on *RCA* color tubes had now reached a point where receivers using these tubes can produce color pictures of increased brightness and substantially the same resolution and stability as pictures produced on standard black and white receivers. Commenting on this advancement, Dr. Jolliffe said that the increase in brightness of the tri-color tubes has been due to the development of an improved red phosphor, making it possible to eliminate the red filter from the front of the tube and thus increase light output two to one, and the use of improved tube techniques which provide a higher light output, using the same applied voltages as used in the original demonstration models. It has also become possible to build a color tube whose length is approximately the same as a standard monchrome picture tube.

There will be quite a color-program schedule for Washington this fall, according to Dr. Jolliffe, who pointed out that a seven-day plan is being pre-

pared to replace the present five-day arrangement, with studio presentations being offered every day from the Wardman Park studios.

THE FAR-EASTERN BATTLEGROUND, with its blazing frontlines, has begun to emphasize, once again, the importance of radio and electronic operations as a key agent for the ground, air, and naval forces. And once again, industry has begun to contribute in a mighty healthy way to the all-out defense effort. Increased facilities of many plants, streamlined purchasing techniques and the well-organized cross servicing program inaugurated under the administration of Maj. Gen. H. M. McClelland, director of communications-electronics for the Joint Chiefs of Staff, have provided an effective flow of material to the Armed Forces, and minimized the initial impact on civilian production. Contributing factors to the effective program have been the extremely well-knit plans which were set up over a year ago when the National Security Resources Board announced its plans for industrial mobilization. Meeting with members of the trade associations, Arthur M. Hill, then NSRB chairman, revealed how industry was to be mobilized, should war come, and what steps were to be taken immediately as a measure of preparedness. Plans provided for the use of over 600 plants for the manufacture of small and large types of components, equipment, and special products.

A few weeks prior to the Hill meeting, the Signal Corps had held a special conference, during which Major General Spencer B. Akin, the Army's Chief Signal Officer, and Leighton H. Peebles of the NSRB, reviewed how industrial mobilization would be expedited. The now-familiar *contingent-contract plan* designed to shorten conversion time from peace to war production was proposed at that meeting.

With the plans discussed at these and subsequent meetings relayed to industry, manufacturers had become oriented to the emergency requirements and thus when the critical era did appear some months ago, apparatus for the military began to be processed with a minimum of confusion.

As the situation became more and more tense, accelerated production schedules were studied, and the possibilities of enlarged groups for special advisory council work were reviewed. One group which has been proposed now would serve the Signal Corps, and assist the corps in industry relations, provide technical and military assistance in obtaining equipment and personnel and also assist in the training of Signal Corps personnel with industry. This proposal was made at a meeting held in the Pentagon and attended by Brig. Gen. David Sarnoff (SCR) of *RCA;* William H. Harrison, *I.T.&T.* prexy, a major general in the Signal Corps reserve; Carrol O. Bickelhaupt, *A.T.&T.* vice-

prexy, an SCR brigadier general; and W. W. Watts, *RCA* vice-prexy in charge of engineering products, a Signal Corps reserve colonel; as well as members of the Army which included Lieut. Gen. T. B. Larkin, assistant chief of staff, G-4, U. S. Army General Staff; Maj. Gen. J. K. Christmas, chief, Procurement Division, Office of the Assistant Chief of Staff, G-4, and Maj. Gen. S. B. Akin, Chief Signal Officer of the Army.

Aware that eventually industry will be called on to produce much more than anticipated in the pre-Korean days, two billion four hundred million dollars' worth of equipment being the current estimate, and that consumer production could suffer under such a production load, an expanded mobilization plan has been initiated under the guidance of a National Electronics Mobilization Committee, with RTMA Prexy Robert Sprague, who is also president of *Sprague Electric*, and *RCA* Prexy Frank Folsom as chairmen of the group. Describing the activities of the new committee, Sprague said that the group wants to get an early start on procurement requirements and problems, and avoid the pitfalls which faced industry when World War II flared up. Commenting on present conditions, Sprague declared that the defense requirements impact on the components industry, the backbone of radio and television manufacturing, would not be as severe as initially expected. It was his opinion that, barring any unforeseen developments in the world situation, manufacturers would be able to maintain a rather substantial civilian production until at least '51. He also felt that it should be possible to produce the 6,000,000 television sets, estimated for the year, as well as the 10,000,000 radio sets.

The general consensus on military production was that there might be about a 20% bite into civilian activities, but that most plants were well able to carry this additional requirement, without any severe dislodgement of distribution.

WORLD EVENTS have prompted the processing of many new sets of rulings by the FCC, one of the most important of which have been those governing a Disaster Communications Service.

Defining disaster communications, the Commission cited that two classifications shall exist: communications when there is no impending or actual disaster, and communications when the emergency does exist.

When all is quiet, the Commission points out that the service can be used for drills and tests to insure the establishment and maintenance of efficient networks of disaster stations. These drills and tests may include the pre-arranged exchange of communications by stations of established networks with stations outside of any established network, provided that the purpose of such an exchange is to provide training and practice. When disaster hits, the service must then be used to provide communications directly concerning safety of life, preservation of property, or maintenance of law and order by authorized government agencies, as well as other vital types of contacts essential in emergencies.

Any amateur radio operator license issued by the FCC authorizing operation of a ham station will give the operator the necessary authority to operate an authorized disaster station in the 1750- to 1800-kc. band. And any commercial radio op license qualifies its holder to operate an authorized disaster station. The rules specify that all transmitter adjustments or tests, during or coincident with the installation, servicing, or maintenance of a disaster station, which may affect its proper operation, will have to be made by or under the supervision and responsibility of the holder of the ham or commercial op tickets.

Discussing licenses for the new stations, the Commission stated that they may be obtained by filling out application form 403. The licenses normally will be issued for an original term of from one to four years. Special calls will be issued for the disaster operation, and each station will have to use these calls at the beginning of each series of contacts, repeating the call at least once every fifteen minutes.

Congratulations to the FCC for their vision in creating this powerful medium of contact for those moments of desperate need! . . . . . L.W.

INEXPENSIVE TRANSMITTER METERING

By FRANK R. CANNING, W2GCB

THE desire to meter all stages of a new five-stage, four-band exciter came into conflict with the fact that our only meter was a 100 ma. unit—far too large to measure small grid currents. This meter was already doing duty in the power amplifier, and switching it into the exciter looked like too much trouble. As the exciter was designed expressly to eliminate our TVI problem, all frequency multiplication was done at very low power—oscillator and frequency doublers all being 6K7's at only 150 volts. Hence, overloading was hardly likely, and all that was really needed was some means to indicate resonance in the various tank circuits.

This is accomplished in the manner shown in the circuit of Fig. 1. The ray-control grid of a 6E5 "magic eye" tube is switched to the control grids of the different stages of the exciter. The rectified d.c. grid bias voltage present on the grids thus controls the angle of the shadow on the 6E5's target—the higher the bias, the narrower the shadow. To adjust any plate tank to resonance, just switch the 6E5 to the following grid and tune for narrowest shadow.

At the plate voltage used here, 150 volts, the 6E5 requires only —4 volts or so to close the eye. If any stage normally operates at bias voltages over this value, the voltage applied to the 6E5 must be reduced. This is done by tapping the grid leak at a point that just closes the eye when the preceding stage is resonant. For low-power stages a potentiometer may be used; for tubes running appreciable grid current a wirewound resistor with sliding tap is better. If a tube like the 807, which usually requires a definite value of grid current, is used, a meter should be connected temporarily in the grid return and the excitation adjusted for rated current. Then the potentiometer should be set so the eye just closes, and the meter can be removed.

With the 6E5 still plentiful on the surplus market, the cost of the tube, switch, two resistors, and one condenser is still below the cost of even an inexpensive meter, and it will tell you anything a meter will. For that matter, there's no reason why you couldn't permanently connect a 6E5 in every stage of the transmitter, instead of switching. Any way you look at it, it's a bargain.

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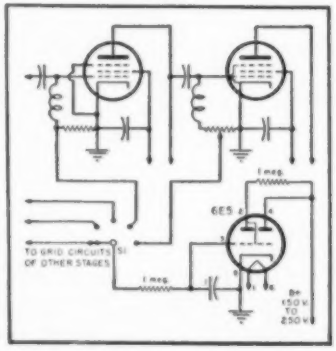
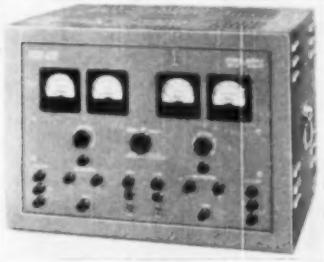
Fig. 1.



What's New in Radio

(Continued from page 99)

rent and voltage meters. Each d.c. output voltage is continuously variable from 200 to 500 volts, 0 to 200 ma. For all output voltages, the output



voltage variation is less than ½ percent for both line fluctuation from 105 to 125 volts and load variation from minimum to maximum current. Ripple voltage is less than 5 millivolts. Each a.c. output is 6.3 volts, 6 amperes, center-tapped and unregulated. Power requirements are 600 watts.

The power supply is housed in a cabinet measuring 14" x 21" x 14¾" and finished in gray hammertone.

NEW SEALED RELAY

Designed for a variety of commercial, industrial, portable, and military equipment, the new 8744-1 sealed relay manufactured by *Advance Electric and Relay Co.* of 2435 North Naomi Street, Burbank, California, has passed all tests and requirements of the Army Signal Corps and the Air Materiel Command at Wright Field.

The hermetically sealed unit is small in size and features three stud mounting and solder lug terminals. The enclosure will accomodate three ampere rated relays in contact combinations up to and including 4 pole, d.t. Measurements are 1 7/16" x 1 5/8" x 1 1/16".

NEW MULTITESTER

Chicago Industrial Instrument Co., 536 West Elm Street, Chicago 10, Illi-

nois, has recently added a new multitester to its line of test equipment.

Several new features have been incorporated into the instrument, including ranges not usually covered in

equipment of this type. There are seven ranges of a.c. and d.c. volts to 5000; 0 ohms to 1000 megohms in six ranges; capacitance coverage from 50 $\mu\mu$fd. to 5000 μfd., and current readings from 0 to 500 ma. in four ranges.

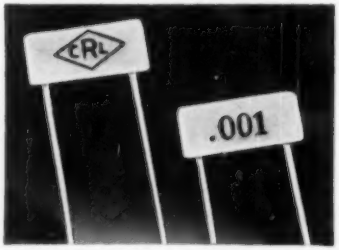
The entire unit is housed in a case with a specially designed sloping front panel which tips upward to provide better meter visibility. The instrument may be used either in an upright position or lying flat by removing and rotating the panel in the case. The 5½" meter gets the full benefit of overhead lighting and is easy to read whether the user is sitting or standing.

A descriptive folder on the new instrument is available on request.

FLAT-PLATE CAPACITORS

The *Centralab Division* of *Globe-Union Inc.* of Milwaukee, Wisconsin has developed a new line of ceramic flat-plate capacitors which offer higher capacities than have been heretofore available.

The new units are of unusual thinness making them particularly useful in many electronic applications. They



are available in .02, .05, and .1 μfd., all rated at 600 volts.

An even smaller version is available in lower voltage ratings. Known as the "Min-Kaps," these units are designed for miniature applications and are rated at 150 volts. The "Min-Kaps" measure just $\frac{17}{32}$" x $\frac{7}{32}$" x $\frac{7}{64}$".

OSCILLOSYNCHROSCOPE

Browning Laboratories, Inc. of Winchester, Massachusetts, is currently in production on the Model OJ-17 oscillosynchroscope which has been specially designed for laboratory applications.

The high gain vertical amplifier has a response flat from 5 cycles to 16 mc., extending beyond 30 mc., including the use of a .2 microsecond signal delay line. Two completely separate sweep systems permit accurate display of repetitive phenomena with recurrence rates as high as 10 mc., or transient and recurrent pulses as short as .05 microseconds.

Built-in trigger and delay generators are provided for synchroscopic applications such as those encountered in radar circuits.

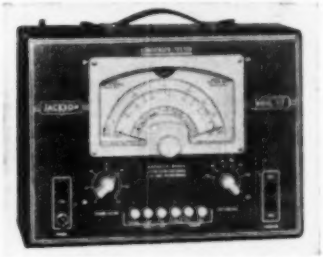
Accurate time measurements may be made by use of .1, 1, 10, and 100 microsecond timing markers. Vertical signal amplitude measurements are also possible using a direct reading deflection calibration system. The

high voltage cathode-ray tube employed provides a trace sufficiently bright to be photographed even under high writing rate, single sweep conditions.

The OJ-17 consists of five separate chassis units assembled in a rack cabinet mounted on casters. A compartment is provided for permanent installation of an "Oscillo-Record" camera.

CONDENSER TESTER

The Jackson Electrical Instrument Co. of 18 South Patterson Boulevard,



Dayton 1, Ohio, has added a fourth instrument to its "Challenger" line series.

The new instrument is a push-button controlled condenser tester, the Model 112. It provides fast, positive range selection for capacity and leakage tests. The unit is capable of checking all types of faulty condensers including electrolytics, papers, micas, etc. The instrument uses a new method for leakage tests which eliminates the counting of flashes on the electron ray tube indicator. Six test voltages from 20 to 500 volts are available. The dial is glass-enclosed and equipped with the company's "Scale Expander" pointer which doubles the effective scale length.

IMPEDANCE BRIDGE

Broun Electro-Measurement Corporation of 4635 S.E. Hawthorne Blvd., Portland 15, Oregon, is currently in production on a new Model 250-B uni-

versal impedance bridge and the companion Model 850-B bridge amplifier.

Because of its small size and light weight the new instrument is particularly well suited for portable applications.

The bridge features the use of wire-

wound resistors which are adjusted to a precision of ± .05% in the bridge arms. A directly calibrated slide wire consisting of a .05% precision decade with a coaxially mounted single turn rheostat for interpolating within the decade steps is used as the main *LRC* dial.

Included in the compact aluminum cabinet are the precision reference standards, 100 c.p.s. tone generator, zero center suspension galvanometer with a deflection sensitivity of ½ μa./mm., and four replaceable flashlight cells to power the bridge.

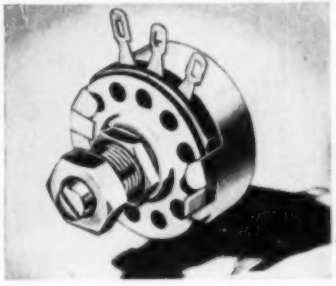
The accessory null amplifier may be placed in a compartment in the bridge and has a rectifier circuit which permits the bridge galvanometer or other suitable meter to be used as a visual null indicator.

Bulletins giving full details on both of these units are available from Dept. RN-2 of the company.

NEW POTENTIOMETER

Ohmite Manufacturing Company of 4974 Flournoy Street, Chicago 44, Illinois, has recently introduced a 2-watt molded composition potentiometer with linear taper.

Known as the Type AB locking shaft potentiometer, the new unit is



particularly suited for industrial and military applications where resistance adjustments are infrequent and where tampering with the adjustment must be discouraged.

According to the company, the solid-molded resistance element, heat-treated under pressure, is unaffected by heat, cold, moisture, or length of service. The terminals are imbedded in the resistance element and all parts are corrosion resistant.

The new Type AB potentiometer is available in sixteen stock resistance values from 50 ohms to 5 megohms. The unit is 1 1/16" in diameter and extends 5/16" behind the panel. A s.p.s.t. switch, to be attached to the back of the control, can be supplied at extra cost.

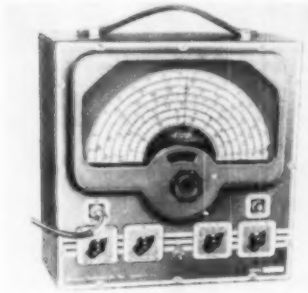
For complete information on the new unit, write to the company for a copy of Bulletin 131A.

SIGNAL GENERATOR

Of interest to service technicians, engineers, and hams is the announcement from *Electronic Instrument Co., Inc.* of 276 Newport Street, Brooklyn 12, New York, that it has released its

Model 315 deluxe r.f. signal generator in kit form.

Designated the Model 315-K, the new unit may be used for TV, FM, and AM receiver alignment. Featur-



ing an accuracy better than 1% on all seven separate calibrated ranges, the Model 315-K has a stable, boosted range oscillator circuit that covers the full range of 75 kc. to 150 mc. Bandspread vernier tuning is provided. The illuminated gear-driven pointer is designed to prevent backlash, and the special 0-100 reference scale speeds repeat settings.

Due to a VR tube circuit, the accuracy of the Model 315-K is independent of line voltage fluctuations from 105 to 130 volts. The four-step shielded r.f. output attenuator is designed for constant output impedance.

For full details on the new Model 315-K signal generator kit, write direct to the company at the above address.

LOW TORQUE POT

An ultra-low-torque potentiometer, incorporating design characteristics new to the precision instrument field, has been announced by *Electro-Mec Laboratory* of 225 Broadway, New York, New York.

The new potentiometer may be used in any installation where an exceedingly small mechanical moving force needs to be converted into a corresponding electrical voltage. Designs

of the new unit are available to carry currents as high as .1 ampere and with outputs sufficient to operate indicating, recording, or controlling devices, without amplification, thus offering substantial savings in cost, size, and weight, according to the manufacturer. Resistance values between 50 and 200,000 ohms are provided.

Complete data on the new potentiometer will be furnished on request.

SENSITIVE RELAY

The new Series 1816, just introduced by *Assembly Products, Inc.* of Chagrin Falls, Ohio, is a sensitive relay with heavy-duty ratings.

The coil of the new unit is 15,000 ohms and operates on 5 ma. d.c. Contacts are snap action and will handle 15 amps, 115 volts or 7½ amps., 230 volts a.c. The standard units are s.p.d.t. or d.p.d.t. but other coil and contact combinations can be furnished.

Designed for high differential between pull-in and drop-out, the relay is normally high speed in action. However, it may be used for time delays from a fraction of a second up to 30 seconds or more by the use of condensers connected across the field.

The coil is thoroughly impregnated against moisture. The relay may be mounted in any position. Over-all dimensions are 1¼" wide, 2½" long, and 1¾" high. The relay weighs 5 ounces.

PRECISION RESISTORS

Shallcross Manufacturing Co., Collingdale, Pa., has announced the availability of an improved vertical style precision wirewound resistor for use

where mounting requirements make it desirable to have both terminals at the same end of the resistor. These units provide a longer leakage path from the mounting screws to the terminals.

The company's units incorporating this new design feature have been designated as the Types BX120, BX140, and BX160. All types are designed to meet JAN requirements for styles RB40B, RB41B, and RB42B respectively. For commercial use the resistors carry somewhat higher ratings than for JAN applications.

Complete details will be furnished on request to the manufacturer.

VERSATILE TESTER

Electronic Measurements Corp. of 423 Broome Street, New York 13, New York, has recently introduced a new tube-ohm-capacity tester which has been designated the Model 202.

The instrument is designed to test all tubes including the noval and subminiature types. Standard emission

method of testing gives easy, direct reading. Individual sockets are included for each type of tube base, which tests all tubes from .75 volt to 117 filament volts.

Additional features of this new test instrument include a completely flexible switching arrangement, a line voltage control that compensates for line variations between 105 and 135 volts, and a check for shorts and leakages.

Condenser leakage can be checked to 1 megohm, resistance to 4 megohms, and capacity from .01 to 1 *mfd.* The entire unit is housed in a portable oak case with carrying handle. The built-in roll chart is protected by a non-breakable transparent plastic.

INSULATED GROMMET

A metal formed grommet, completely covered by rubber, has been developed by *Automotive Rubber Company, Inc.* of 8601 Epworth Blvd., Detroit 4, Michigan.

Of interest to the electrical and electronic field, the new "Sta-Put" series 3120 grommets can be installed easily and quickly by means of an expanding hand tool. The tool is used to roll and force the grommet's curled prongs tight against the under surface.

The company claims that regardless of the amount of motion or vibration

in the part that passes through the hole the grommet will not loosen or pull out and expose the sharp edges of the blanked metal.

Data sheets listing the present available sizes and full details on the line are available on request from the company.

CAPACITY BRIDGE

Simpson Electric Company of 5208 W. Kinzie Street, Chicago, Illinois, has recently introduced a new bakelite-encased capacity bridge, the Model 381.

The new condenser tester measures just 3⅝" x 5½" x 2⅜" and weighs 1¾ pounds. A special patented circuit allows for three capacity ranges, 20 μμfd. to 500 μμfd., .005 μfd. to 2 μfd., and 1 μfd. to 500 μfd.

The panel is of rust-resistant etched aluminum which is easy to read under all conditions. Complete instructions for switch setting come with each instrument.

D.C. POWER SUPPLIES

Opad-Green Co. of 71-3 Warren Street, New York 7, New York, has recently introduced a new series of general purpose, low-voltage d.c. power supplies.

Featuring continuously variable outputs on all models, these units carry continuous duty ratings of 10 amperes. They are available in ranges of 0-8 volts, 0-12 volts, and 0-28 volts d.c. The a.c. input requirements are 115 volts, 60 cycles single phase. A variable voltage transformer and a fixed ratio transformer insure minute and precision control of the d.c. output, according to the company.

The d.c. voltage and current may be read directly on two 3" meters. The ammeter is calibrated in steps of 200 ma. and has a full scale value of 10 amperes. Bench space requirements are 8"x16¾". A descriptive bulletin, GPA1, is available on request. —30—

Max Liebowitz (left) president of the Empire State Federation of Electronic Technicians, presents Hal Bersche, Renewal Sales Manager of RCA Tube Department, with certificate of appreciation for department's cooperation and participation in a television service course for independent technicians conducted by the ESFETA. The New York association's TV service series featured lectures by J. R. Meagher and A. J. Petrasek, RCA TV specialists.

AFCA NEWS

This Association is a patriotic non-profit organization, with chapters in most of the larger cities, dedicated to developing and maintaining efficient personnel, commissioned, enlisted, civilian, for the supply (including design and development), installation, maintenance, and operation of communications and electronic equipment for Army, Navy, and Air Force and their supporting civilian activities. It publishes a magazine "SIGNALS" at its national headquarters in Washington. Every American interested in any way in communications is eligible and invited to join. Dues are $5.00 per year. Application should be submitted to the secretary at 1624 Eye St., N. W., Washington 6, D. C., who will furnish details upon request.

AFCA NEWS

Augusta-Camp Gordon

The chapter's July 27th meeting took place at the Sheraton Bon-Air Hotel in Augusta. Plans were announced for the August meeting which will feature a conducted tour of the *Southern Bell Telephone* plant at Augusta.

The guest speaker of the evening was Lieutenant Griffith of the Signal Training Regiment of Camp Gordon, who recently returned from Korea. He gave a most interesting talk on the current situation and his address was followed by Signal Corps movies taken in Korea.

At the conclusion of the program, the members and guests adjourned to the penthouse for a buffet supper.

The officers and directors of the Augusta-Camp Gordon Chapter held a luncheon meeting August 3rd at the Camp Gordon Officers' Club. The meeting was occasioned primarily by the presence of Col. George P. Dixon, AFCA National Executive Secretary, who stopped at Camp Gordon enroute to Atlanta.

In addition to Colonel Dixon, those present included: W. H. Mansfield, AFCA National Director and Secretary of the *Southern Bell Telephone Company;* Ralph Grist, Coordinator of Military Services, *Southern Bell Telephone;* Charles Eberhart, Marion Symms, and Hugh Fleming, all of *Southern Bell* of Augusta; Henry Wright, Associate Editor, "Augusta Herald"; Col. Henry J. Hort, chapter president; Lt. Colonels Thomas K. Trigg, Edward W. Butzke, and Marcus W. Heskett, and Majors Walter J. Hewitt and Norman J. Kinley, all of Camp Gordon.

After luncheon, Colonel Dixon gave an informal talk and then led a round-table discussion on chapter problems. All present had an opportunity to comment or ask questions. Interest revolved mostly around the type of programs on which meetings could be built. Colonel Dixon stated that he had inquired of fifteen separate corporations as to whether they would be willing to sponsor lectures or demonstrations to AFCA chapters and had been gratified to receive twelve replies indicating interest in the idea. He remarked that once chapters are aware of this and dates can be coordinated so that tours could be efficiently made, all concerned can look forward to an interesting series of programs.

Baltimore

The 1950-51 executive committee of the chapter held its first meeting on July 13th in the offices of the *Bendix Radio Division.* Present were: Wilbur L. Webb, president; E. K. Jett, past president; Walter Evans, past president; Capt. Richard E. Elliott, USN, vice-president; Col. Henry W. Williams, vice-president; George C. Ruehl, Jr., secretary; E. K. Foster, chairman of student activities; Donald C. Lee, program committee chairman; and Clinton H. Johnson, publicity committee chairman.

The program for the ensuing year was discussed and numerous ideas were proposed and noted by the program chairman. It was decided that the first meeting of the new year be held in late September at a downtown hotel in Baltimore and that it be a social affair enabling the new officers and members to become acquainted.

The possibilities of organizing student chapters were considered and E. K. Foster, general manager of *Bendix Radio,* was appointed chairman of a committee to develop this phase of chapter activity.

Group membership came in for considerable discussion and it was decided that President Webb would discuss the potential group members with Colonel Dixon, AFCA Executive Secretary, at an early visit to national headquarters in Washington.

Cleveland

The Board of Directors of the Cleveland Chapter met on June 21st in the Union Commerce Building to elect officers and make plans for the coming year. The directors are: L. J. Shaffer, *Ohio Bell Telephone Company;* V. G. Krebs, National Advisory Committee for Aeronautics; W. McClusky, *Citizens Telephone Company;*

T. F. Peterson, *American Steel & Wire Company;* G. F. Prideaux, *General Electric Company;* C. H. Endress, *Willard Storage Battery Company;* L. K. Wildberg, *Radiart Corporation;* T. R. Beatty, *National Carbon Company;* and L. A. King, *The Rola Company, Inc.*

The following slate of officers was unanimously elected: L. J. Shaffer re-elected president; V. G. Krebs, 1st vice-president; W. McClusky, 2nd vice-president; T. F. Peterson, secretary; G. F. Prideaux, treasurer; C. H. Endress, member, executive committee.

President Shaffer reported on the national council meeting and the chapter presidents' conference which he had attended at the AFCA annual convention in May.

Detroit

Elwyn C. Balch, chief engineer of the *Michigan Bell Telephone Company,* was elected president of the Greater Detroit Chapter at its 1950 annual business meeting on June 13th in the New Veterans Memorial Building.

Other officers elected were: 1st vice-president—George H. Goldstone, attorney, reelected for a second term; 2nd vice-president—Charles E. Quick, *Detroit Edison Company,* reelected for a second term; 3rd vice-president—Lt. Col. Peter D. Green, director of communications, 10th Air Force; secretary—Leo J. Ritter, *New York Central Railroad Company;* assistant secretary—D. J. Basolo, *Michigan Bell Telephone Co.;* treasurer—W. Clare Edwards, *Michigan Bell Telephone Co.;* assistant treasurer—James V. Grann, *Jam Handy Corporation.*

The chapter constitution and by-laws, previously approved by national headquarters, were formally adopted by the membership.

The other business of the meeting was devoted to the problem of securing greater attendance at chapter meetings and the question of obtaining additional members. A committee was also appointed to look into the matter of having the chapter make awards to outstanding students in ROTC communications units at various universities and colleges in the Greater Detroit area.

Fort Monmouth

At a meeting of the chapter's Board of Directors on July 18th, committee chairmen were appointed as follows: membership—Capt. David M. Uhler; meetings—W. L. Seibert; industrial relations—Arthur F. Daniels; reserve affairs—W. F. Atwell; public relations—Lt. Col. B. Abramowitz; financial—Maj. James McClung; memorial—Maj. H. E. Maxwell; group membership—Lt. Col. Robert Haffa.

Capt. David Uhler and Col. E. A. Kenny were elected to fill vacancies on the Board until the annual election in November. Lieut. Stanley B. Upchurch was appointed treasurer to succeed Miss Florence Adair who had resigned.

The financial report covering the AFCA convention at Fort Monmouth in May was presented to the Board and was approved. After considerable discussion, it was decided that the chapter would suspend meetings during August and September and would make plans for an enthusiastic meeting in October, to be supported by a good speaker and entertainment and food, at chapter expense.

Philadelphia

Philadelphia Chapter members turned out en masse for an informal dinner dance on June 10th in honor of their president, W. W. Watts, Vice President of *RCA Victor Division*. During the evening, Col. R. R. Rinkenbach, program committee chairman, presented Colonel Watts with a hand carved shield bearing the AFCA emblem and the words "Colonel W. W. Watts, Organizer, First President, Philadelphia Chapter, 1947-1950."

The gathering took place at the Officers' Club of the Philadelphia Quartermaster Depot and was attended by some 400 members and guests.

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International Short-Wave

(*Continued from page* 136)

clearly marked. Bellington, N. Y., and Sutton, Ohio, say both 15.341 and 11.896 (measured channels) have news 1400; however, on Sundays I find these have music instead of news.

Germany—DTSP, 15.28, Munich, noted in point-to-point broadcast to New York at 1015. (Russell, Calif.)

"Radio Free Europe" is the name of a *new* station in Western Germany; operates on 6.135 daily 1200-1800; is an American station directed to Eastern Europe. (Radio Sweden)

Radio Frankfurt now sends QSL card (formerly sent letter). (Pearce, England)

Orchwall, Sweden, says the *new* Berlin (Russian Zone) station on 6.115 is heard well at 0000; Pearce, England, received letter verification from this one for its 6.115 and 7.140 outlets, but no details were given.

Greece—The Greek Forces Station, Kavala, is heard on 7.650 to leaving the air 1500. (Radio Australia) *Radio Sweden* lists its schedule as daily 0530-0800, 1200-1500 (Sundays to 1600).

Radio Athens, 15.345, is good level in N. C. during 1730-1745 news. (Parker)

Guatemala—TGWA, 9.76, Guatemala City, now runs *after* 0000; heard some nights as late as 0200. (Bellington, N. Y.)

Haiti—4VEH, Cap-Haitien, has been measured on 9.886 but at times has been found as low as 9.880; good signal evenings and 0700-0800. (Ferguson, N. C.) Heard signing off around 2102 in French and *English*. (Allen, Mass.) 4VRW, Port-au-Prince listed 10.135, recently was noted back on approximately 9.790 when identified 2053 in *English* as 4VW and 4VRW, affili-

ated with *CBS* and United Nations Radio; asked for advertising; said is on air 10 hours daily but that may be for only 4VW, m.w. outlet. (Stark, Texas) 4VCN, 6.407, Port-au-Prince, noted with music 2000, good level in Dela. (Cox)

Honduras—HRN, approximately 5.875, Tegucigalpa, noted with good signal around 2230. (Russell, Calif.)

Hungary—Budapest is now sending QSL card. (Pearce, England)

Iran—Radio Teheran, 15.100, noted with good signal in news 1500-1505, then dance music to 1530 closedown. Staples, England, reports EQC, 9.660, in parallel.

Israel—4X4VA, Tel Aviv, is back on the air on 6.726 and 12.250; *English* music 1240-1400; outlet on 6.726 is putting in strong signal in Lebanon and Syria. (Radio Sweden) Tel Aviv, 9.018, 6.830, news still at 1415. (Pearce, England)

Italy—Rome is still moving around. Noted with news 2110 for West Coast on 9.630, 11.810, 11.905, 15.120, 17.820 (Saylor, Va.) Seems to have extended schedules considerably, especially for *English* newscasts.

Jamaica—ZQI, Kingston, seems to have changed schedules recently; noted in N.C. signing off 2300 on 4.950; also noted around 0625 on same channel. (Ferguson) Heard with news 2130, some CWQRM. (Saylor, Va.) Bellington, N. Y., reports the 3.480 channel at 2030 with news. Kroll, N. Y., lists QRA of this one as Jamaica Broadcasting Co., The Government Broadcasting Station, 2 Seaview Avenue, Half-Way Tree, Kingston, Jamaica, B.W.I.

Japan—JBD3, 15.235, noted with poor signal 0000, QRM'd by Moscow. (Balbi, Calif.) JKM, 4.930, noted signing off 0730; Tokyo, 4.86, noted to *after* 0815, excellent quality. (Russell, Calif.)

Korea—When this was compiled, HLKA, 7.933, Seoul, under control of the North Korean Communists, was being heard with weak signal in Oregon around 0830, through heavy CWQRM; *no English noted.* (Neeley) *Pyongyang Radio* was being heard in Calif. with excellent level 0730, off 1015; *no English noted.* (Russell, Balbi) Frequency of Pyongyang is approximately 4.500.

Luxembourg—Radio Luxembourg, 6.090, noted Saturdays 1700 with "Bringing Christ to the Nations" (*English*). (Pearce, England)

Madagascar—Radio Tananarive is reported on 6.170, heard in New Zealand signing off at 1430. (Radio Australia) Stark, Texas, and Bellington, N. Y., have been hearing a station on approximately 9.515 from 2230 sign-on that they believe is Tananarive. Not noted Saturday nights, so may be off then or may come on later that day.

Malaya—BFEBS, 11.88, Singapore, has QRM mornings from XEHH, Mexico City. (Neeley, Ore.) The Blue Network, Singapore, outlet on 7.250 still heard with news 0900. (Deskins,

Calif.) Harmonic noted some days on 14.500. (Neeley, Ore.)

Malta—FBS, Middle East, noted in England on 11.895 at 1015 asking listeners to retune to 7.220; noted 0225 on 7.220 and at 0230 with BBC relay; from 0400 could be heard in parallel on 11.895. (Pearce)

Mexico—The Mexican Hoof and Mouth Disease Control Commission station, X9BGG, heard in Dela. 0133 testing on 5.880; good signal for 50 watts. (Cox) XDY, 9.919, Chapultepec, *"Radio Mex,"* listed 20 kw., noted 2145 with poor signal in N.C. (Parker)

Mozambique—Lourenco Marques noted with *English* program on 11.764 mornings to *after* 0830; Portuguese program noted around 0000 on approximately 9.805. (Stark, Texas) Neeley, Oregon, says the 9.805 channel has good to fair signal but is badly "mauled" by AO carrier on about 9.807.

The 4.93 channel, with *English program*, is sometimes audible to fair in the Eastern U.S. from 2300. (Cox, Dela., Bellington, N. Y.)

Pearce, England, hears the Portuguese program on approximately 9.805 to 1500 or later when signs with "A Portuguesa"; Portuguese news 1320.

New Caledonia—Radio Noumea, 6.038, will soon have *English* broadcasts for listeners in New Zealand; present schedule is 0200-0540. (Cushen, N. Z.) At times has QRM from *Radio Monte Carlo*. (Bellington, N. Y.)

New Zealand—Radio New Zealand now often takes relays from 2YC instead of 2YA. (Neeley, Ore.)

Nicaragua—YNMG, 8.007, *"La Voz de Jinotepe,"* noted 2145-2300 sign-off; suffers intermittent CWQRM but signal is fair to good; power appears 100 watts. (Neeley, Ore.)

Nigeria—The *"Voice of Nigeria,"* Lagos, is reported on 9.490; frequencies listed by the station in verifying, however, were 6.035, 9.655; times of transmissions were listed 0100-0230, 0600-1700 (Sundays 0100-1700). (Radio Sweden)

Norway—Radio Sweden reports that the *English* program *"Norway This Week"* is now 15 minutes earlier, that is, Sundays at 0700, 0900, 1500, 1900, and 2100.

Outer Mongolia—Ulan-Bator, 8.400, is still heard mornings in the U.S., noted 0545 in N. J. with S-7 signal; man in native language. (Oskay) Russell, Calif., reports Ulan-Bator on 5.265 around 0615.

Pakistan—Karachi, 17.835, noted fair in news 0105-0116, some QSB. (Sutton, Ohio) At the time this was compiled, *Radio Pakistan* was being heard in Eastern USA with news 2100 on both 15.335 and 15.270 (latter with bad QRM from "Voice of America" on same channel). Karachi, 17.835, noted 1200 by Wadhams, Calif. Pearce, England, was hearing the 11.885 channel with news 1230.

Panama—Slutter, Pa., reports HOJA, *"Radio Provincias,"* Panama City, 9.642, at 2000 with music; listed

300 watts; noted in New York 2015-2030 by Bellington. HOXB, 11.810, Panama City, noted in Calif. by Russell around 2330, signing off 0000.

Peru—OAX1B, 6.197, Piura, heard 2038, music. (Cox, Dela.) OAX4W, 9.375, Lima, noted with good level—some CWQRM—2000-2030. (Parker, N. C.)

Philippines—DZH3, 9.500, Manila, has *NBC* news 1100 when battles with XEWW, Mexico City. DZH2, 9.64, Manila, heard around 0930, fair level; announces DZRH, 650 kc., 10 kw., as well as DZH2, 1 kw. (Neeley, Ore.) Davao, 3.950, heard 0530. (Radio Australia)

Rosenauer, Calif., received a letter and QSL card from the Far East Broadcasting Co., Manila, which operates DZAS, 680 kc., 10 kw.; DZH6, 6.030, 1 kw., and DZH7, 9.730, 3 kw. DZH6 uses a center-fed dipole antenna; DZH7 uses a "V" beam directed on Bombay, India. According to the letter, the station expects soon to have a more powerful transmitter, to operate in the 16- or 19-m. band, using a rotating beam antenna; according to the QSL card, additional calls assigned include DZH8, DZH9.

DYH4, Ilalio City, has been heard testing on 6.055 and 840 kc. from 0500 to 0700, with some sideband QRM from YDF, 6.045, Djakarta, USI; however, reception is generally good in New Zealand; call is DYSB on 840 kc., m.w.; reports have been requested frequently to DYH4, Ilalio City, Philippine Islands. (Cushen, N. Z., via Radio Australia)

DZ13, 6.110, Republic Broadcasting Corporation, Calvo Buildings, Escolta, Manila, Philippines, operates 1600-1200; owner is Bob Stewart, formerly of DZAB-DZH5; chief engineer is Jose Guevarra. (Cushen in *N. Z. DX Times*)

"The People's Station," 6.170, Manila, noted with news 0745. (Balbi, Calif.)

Portugal—OTC, Leopoldville, reports *Emissora Nacional*, 15.015, Lisbon, is heard in Sweden 1000-1200. (Neeley, Ore.) This may be the "unknown" widely heard in USA early mornings and afternoons to around 1600; Oskay, N. J., measured the "unknown" transmitter as on about 15.018. Pearce, England, says Lisbon appears to use 15.100 on Saturdays *only*, other days is heard on about 15.025.

Sao Tome—DX Radio, Sweden, reports CR5SB, 17.667.5, Radio Clube de Sao Thome e Principe, heard 0730-0800 and on 4.800 at 1500-1600.

Saudi-Arabia—Cushen, N. Z., has received verification from Djeddah; it was explained that Djeddah is about half-way along the Red Sea coast and about 80 miles west of Mecca; transmitting equipment includes six 3-kw. transmitters—one on m.w. and 5 on s.w. Currently lists 725 kc., 3.950, 5.975, 9.650, 11.850 (may be 11.750?), and 11.960 (may be 11.950?), with schedule of 0230-0315, 1040-1115, 1230-1345; the first *three* transmissions may be changed soon; studios are now being constructed at Mecca and when completed, a high-frequency (FM) station

will be used to relay to the s.w. outlets at Djeddah.

South Africa—SABC has now replaced *all* BBC news relays with SABC news which is relayed from Johannesburg by land-line to other broadcasting centers. (Hannaford, South Africa)

ZRB, 9.11, Pretoria, noted 0015 relaying SABC news. (Bellington, N. Y.)

Worris, N. Y., has converted these current SABC schedules for me—"A" Program is *English*; "B" program is Afrikaans; "C" Program is commercial ("Springbok Radio" in *English*-Afrikaans). Schedule is 9.87, Johannesburg (A) 0315-0715 (Sun. to 0840); 9.523, Johannesburg (B) 0315-0715; 7.295, Johannesburg (C) 0100-1000 (Sun. to 1015); 7.255, Cape Town (B) 0315-0715, 0900-1130 (Sun. 0315-1130); 5.88, Cape Town (B) 2345-0130 (no sign-on Sat., Sun. signs on 0055), 1145-1605 (Sat. to 1645), carries "A" Program Wed. 1320-1605; 4.895, Johannesburg (B) 0900-1350 (Sat. and Sun. from 0725); 4.878 Pietermaritzburg (B) 2345-0130 (no sign-on Sat., Sun. signs on 0055), 0315-0715, 0900-1605 (Sat. 0315-1645, Sun. 0315-1605); 4.80, Johannesburg (A) 0900-1130 (Sat. from 0720, Sun. from 0850); 3.45, Johannesburg (B) 2345-0130 (no sign-on Sat., Sun. signs on 0055), 1200-1605 (Sat. to 1645); 3.356, Johannesburg (C) 2345-0130 (no sign-on Sat., Sun. signs on 0055), 1140-1605 (Sat. to 1645).

Surinam—PZC, 15.405, Paramaribo, heard signing off 2107 with fine signal; programs chiefly music with announcements in Dutch; some days has *English* announcements also. (Neeley, Ore.)

Sweden—Radio Sweden has replaced 15.155 with 6.065 at 1300-1700. (Skoog, Sweden)

Syria—Radio Sweden reports Damascus now on 9.590 with news 1630; frequency not confirmed.

Tahiti—Radio Tahiti, 12.080, scheduled now 2300-2345, noted at times with old USAF Network transcriptions (such as Fred Waring, Hit Parade). (Russell, Calif.)

Tangier—Nattugglan, Sweden, reports *Radio International*, 6.110, 1700-1730.

Thailand—When this was compiled, Bangkok was noted with its 0500-0630 *English* program on 6.010 and 11.910; announces a 19-m. outlet but this was not then audible in Melbourne . (Sanderson, Hutchins, Australia)

Trieste—AFS, Trieste, an American Army Station, is operating on 7.670 at 0000-1800; suffers QRM from *Radio Sofia*, Bulgaria, same channel; the American station also operates on m.w. 1511 kc. (Radio Sweden)

Turkey—At the time this was compiled, *Radio Ankara* had not yet put its *new* 100 kw. transmitter into regular operation; however, tests some time ago over TAT, 9.515, and TAV, 17.840, were reported to have been quite successful (with many reports from all parts of the world), and the *new* transmitter should be in regular use shortly. *Radio Ankara* recently announced in its *Mailbag Program*

(Sundays 1530-1600, TAQ, 15.195) that when the *new* high-powered station comes into operation, services will be greatly expanded, with new beams for listeners abroad.

Uruguay—Radio El Espectador, 11.835, Montevideo, heard signing off 2204, fine level; announces CXA14 and CXA19; uses 3-note chime. (Neeley, Ore.)

USA—AAH of the Alaskan Communications System, Seattle, Washington, heard in Pa. loud and clear on announced 14.8675; also announced 10.72; noted some evenings (EST). (Hankins)

USI—Menado, Celebes, noted on 9.84 (listed 9.72) to 0930 sign-off; sometimes has strong teletype QRM. (Neeley, Ore.) Also heard in Texas, mornings, by Stark.

Cushen, N. Z., airmails me he hears Medium, 4.160, to *after* 1030 and that sign-off "appears" to be 1100; mainly native music, relays news in Indonesian from a network 0930; Kediri, 3.510, heard to 1000; Kotaradja, Sumatra, 8.910, noted 0930; YDG, 3.332, Surakarta, noted signing off 1030.

Here are current schedules for *Djakarta Radio*, as received airmail from Thomas, New Zealand—0600-0700, *English*, YDC, 15.150, to Australia-New Zealand, YDB2, 4.910, to Malaya; 0700-0800, Chinese, YDC, 15.150, to China, YDB2, 4.910, regional; 0800-0900, Arabic, YDC, 15.150, to Indonesia, YDB2, 4.910, to Malaya; 0900-1000, Hindu-Urdu, YDC, 15.150, to India-Pakistan, YDB2, 4.910, regional; 1000-1100, *English*, YDC, 15.150, to India-Pakistan-Burma, YDE, 11.770, to West Coast USA-South Africa; 0930-1030, Indonesian, YDF, 6.045, to South East Africa; 1100-1200, Arabic, YDF2, 11.785, to Middle East, YDC, 15.150, to Near East; 1200-1300, French, YDF2, 11.785, to Near and Middle East-Europe; 1300-1400, Dutch, YDF2, 11.785, to Europe-New Zealand; 1400-1500, *English*, YDF2, 11.785, to Europe-New Zealand, and 1030-1130, French, YDB3, 7.270, to Indo-China, and YDB2, 4.910, regional.

USSR—Moscow's "claimed" 11.820 channel, used to North America evenings and mornings, has been measured 11.82491 at 1820 sign-on. (Oskay, N. J.) A Soviet transmitter noted on 15.440 signing on 1200 in German or Yiddish. (Leary, Ind.) *Radio Sweden* says Alma Ata now operates on 9.340 and 9.300; audible in Sweden 0700-1100.

Vatican—HVJ, 15.095, noted 1315 with *English*. (Leary, Ind.)

A letter received by Hartle, Pa., from *Vatican Radio* states—"Regarding the new transmitter donated to His Holiness, it will be at least several months before we can put it into operation, the reason being that many building changes are necessitated by the new installation. However, when put into effect it will definitely make reception of Vatican broadcasts in the States available on a much wider scale than at present." This indicates that the *new* transmitter—reported to be

100 kw. and a gift to the Pope from Dutch Catholics—will operate in the s.w. bands although European sources reported earlier it was for either l.w. or m.w. transmissions. I hope to have further information direct from the Vatican soon.

Venezuela—YVOG, 3.310, Trujillo, 1 kw., has BBC news in Spanish daily 2100, probably transcribed. (Cox, Dela.)

Yugoslavia—Radio Belgrade, 9.505, has changed schedule; noted now with news 0045-0100 when signs off air; announces next *English* broadcast for 1115 (probably over 6.100V). (Bellington, N. Y., and Pearce, England)

* * *

Last Minute Tips

Skoog, Sweden, flashes that the *two new* high-powered short-wave transmitters of *Radio Sweden* will be ready for testing within a few months.

Neeley, Ore., flashes to me that the Papeete, Tahiti, transmitter on 6.980 is *Radio Club de Oceanien* (which at least formerly had call FO8AA); at 2300 sign-on, *Radio Tahiti* announces in French that the 12.080 outlet is *Radio Electrique* while 6.980 is "*Emitteur de Radio Club de Oceanien.*" He also reports the "*Voice of Viet Nam,*" Indo-China, on 9.620, with *English* now 0830-0930; has Indo-China news 0845, editorials 0900, world news 0915; these periods are 5 to 10 minutes in duration and programs are filled in with popular music; 7.265 parallels; at 0930 gives Saigon Time as 2230.

Tel Aviv, Israel, is back on 9.0108 with news 1600; sign-off varies 1630-1645. (Bellington, N. Y.) I recently noted the Home Service opening on approximately 9.615 on a Sunday 0000.

"Unknown" Arabic-speakers heard on 11.75 and 11.95 by Bellington, N. Y., and myself (here in West Virginia), news in Arabic 2320, are believed to be Djeddah, Saudi-Arabia, on new schedule; opens 2300 but sign-off varies around 2350.

Radio Sweden has a "vague" report of a *new* Norwegian station at Vadsoe on 7.010, 20 kw.; no other details listed.

Radio New Zealand has brought some new calls and channels into use. New schedule is 1300-1545, ZL8, 9.620, ZL3, 11.780; 1600-0145, ZL10, 15.220, and Z14, 15.280; 0200-0630, ZL8, 9.620, ZL3, 11.780. (Cushen, N. Z., via Radio Australia)

Hutchins, Australia, reports Viet Nam, Indo-China, on 6.190 with news 0545.

An *English*-speaking station noted on 9.490 at 1425 and signing off 1500 with "God Save the King"; may be Salisbury, Southern Rhodesia; note Salisbury on 3.320 signing off same time. (Pearce, England) If the 9.490 one isn't Salisbury, may be Lagos, Nigeria, also reported this channel.

Airmail flashes from Sanderson, Australia, include BCAF, 8.996, Taiwan, noted 0545, fair signal. Chinese news, and BED2-4, 7.151, noted 0530 with news; Kuala Lumpur, 6.025, Malaya, noted 0830, and *Radio Malaya,*

7.200, Singapore, noted 0630 with news, then stock exchange reports; *Radio Hue*, 7.205, Indo-China, 0600 with news in Vietamese; DYB2, 4.98, Philippines, 0545 with music; *new* DHY4, 6.055, heard 0540 in *English*.

* * *

Press Time Flashes

From Brazil, Serrano airmails this data—*Radio Record*, Sao Paulo, is now transmitting on 6.055 afternoons and evenings (EST), sometimes in parallel with 9.605; still testing. PRN9, 9.29, Rio de Janeiro, now begins transmissions at 1730 (Sunday 1800) with the news program of "Agencia Nacional" (in Portuguese). *Radio Nacional*, also Rio, currently operates 0400-0450, PRL8, 11.72; 0455-1135; PRL7, 9.72; 1138-1515, PRL9, 6.147; 1530-2305, PRL7, 9.72; Saturday and Sunday 0400-0450, PRL8, 11.72, and 0455-2305, PRL7, 9.72. A *new* s.w. transmitter of 50 kw. will be bought from *RCA* to give *Radio Nacional* better coverage of all Brazil. Then s.w. sessions will be carried simultaneously on two channels. PRL7, 9.72, soon may change to 9.505 to avoid QRM from Moscow. There are no plans at present to put in use the 16-m. (17.85) outlet. A letter from "Difusoras del Uruguay," 18 de Julio 1393, Montevideo, Uruguay, confirms reception of the tropical band station CXW, 3.24, 1 kw., horizontal half-wave antenna beamed N-S; relays "Cadena Uruguaya de Radiodifusion" at 1815-1945.

The "unknown" widely heard in the East on approximately 15.020 as early as 0600 and to 1530 closedown has been identified definitely as Lisbon, Portugal. Afternoons is in dual with the 11.04 channel and has news in Portuguese 1515-1530. (Bellington, N. Y., Ferguson, N. C.)

Despite persistent reports that XEWW, Mexico City, had shifted frequency, at the time this was compiled it was measured on exactly 9.500. (Oskay, N. J.)

Radio Dakar, 11.896, 15.341, definitely has *English* news (by woman) daily *except* Sunday 1400. (Pearce, England; Ferguson, N. C.; Bellington, N. Y.)

OZU, 7.26, Copenhagen, Denmark, has added a transmission directed to the Faroe Isles 0830-0850. (Patrick, England)

Students in Oslo, Norway, will operate a station similar to the "merry" Ukesenderen NTH in Trondheim this autumn; probably will be testing by now around 1700-1730 on 6.185, 9.540. (Radio Sweden)

Radio Sweden explains Rome is operating over a *new* station on 6.010, 9.630, 11.905, 15.315, 17.770, 17.805, as well as over the old Busto Arsizio outlets on 11.810, 15.120.

Tel Aviv, Israel, is definitely on 9.018.8 now and has *English* daily 1600-1645. Wants reception reports from the U. S. (Fargo, Ga.)

Radio Noumea, FK8AA, New Caledonia, heard signing off 0530 on measured 6.038.4. (Oskay, N. J.)

Far Eastern Network, 9.605, Tokyo, good in California around 0300; signs off 0330. (Winch)

"Radio Nacional," 15.450, Bogota, Colombia, seems to be a *new* outlet; heard by Ferguson, N. C., at 2130 with news in Spanish; noted by Bellington, N. Y., signing off 2330.

Sao Tome, 17.677, noted on a Sunday recently at 0700-0802 when signed with "A Portuguesa." (Ferguson, N. C.) Sent schedule of 1430-1600 daily on 4.807.5 and each Thursday and Sunday 0700-0800 on 18.677.5. (DeMyer, Mich.)

Djeddah, 11.75, 11.95, Saudi-Arabia, still heard from 2300 sign-on to 2330 to 2350 (sign-off varies); Arabic news 2320. (Bellington, N. Y.)

"Brazil Calling" is heard nightly now at 2005-2030 over ZYK3, 9.565, Recife, Brazil. (Bellington, N. Y.)

Damascus, Syria, is using Arabic, *English*, French, and Turkish on 6.000, 9.550, 12.000 on Fridays 2345-0300, 0400-0800, 1100-1700; Sunday 2345-0300, 0430-0800, 1100-1700; other days 2345-0100, 0600-0800, 1100-1700; *English* is 0600 and 1630. *Radio Algiers* radiates in French 1330-1800 on 9.570; has *two new* s.w. transmitters (25 kw.) under construction. (Radio Sweden)

* * *

Acknowledgements

Thanks for the FB reports; as the winter DX season gets under way, I'll be expecting many more—to 948 Stewartstown Road, Morgantown, West Virginia, USA. . . . . KRB.

Feedback Amplifier

(*Continued from page 68*)

The curvature of the leading edge is an indication of poorer high frequency characteristics. The amplifier's response without feedback may also be seen in Fig. 8C. The small oscillations on the top of the square wave pattern are due to the shock excitation and are quite normal. They are of small amplitude and very high frequency, and have no effect on the amplifier performance in the audio range.

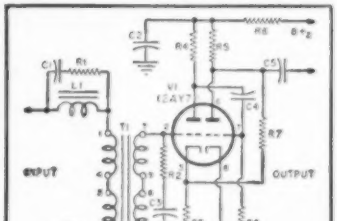
In making square wave tests it is essential that a wide range oscilloscope be used, since otherwise the waveform seen on the screen will be completely different from that entering the oscilloscope. Ordinary oscilloscopes are generally quite unsatisfactory for this purpose, since the required flat frequency range is at least from 10 cycles to 2 megacycles.

The low frequency square wave response is shown in Figs. 8D and E. The extremely slight tilt in the top of the wave is indicative of the large primary inductance (150-200 henrys) and small phase shift (12 windings interleaved) of the transformer.

The amplifier described was designed to be a power-amplifier unit of such optimum characteristics that improvements in other components in a complete system would never make the main amplifier the weak link in the chain. Consequently, there have been no provisions for control functions or frequency compensating equipment, since these could be more readily changed if they were physically separate from the main amplifier.

In order to make a complete unit

Fig. 10. Diagram of a commercial equalizer-amplifier for a variable reluctance pickup.



R_1—18,000 ohm, ½ w. res.
R_2—150,000 ohm, ½ w. res.
R_3—680 ohm, ½ w. res.
R_4—50,000 ohm, 1 w. res.
R_5—50,000 ohm, 1 w. res.
R_6—10 megohm, ½ w. res.
R_7—68,000 ohm, ½ w. res.
R_8—47,000 ohm, 2 w. res.
C_1—.02 μfd., 200 v. cond.
C_2—20 μfd., 450 v. elec. cond.
C_3—.04 μfd., 200 v. cond.
C_4—.02 μfd., 400 v. cond.
C_5—.05 μfd., 400 v. cond.
L_1—Audio choke, 5 hy. @ 25 ma. (UTC HQA-15)
T_1—Input trans. Pri. 50, 125/150, 200/250, 333, 500/600 ohms. Sec. 50,000 ohms (UTC A-11) (The UTC A-10 may also be used)
V_1—12AY7 tube

for highest-quality home listening, the following auxiliary equipment is desirable: 1. Volume Control, 2. Bass and treble equalization, 3. Reluctance-type pickup compensation.

The first control is readily achieved merely by making R_1 a 500,000 ohm potentiometer. This is the only control which can be added to the body of the amplifier. Any additional tone controls or equalizing circuits must be placed before the amplifier, since if inserted internally, they would upset the feedback loop.

An excellent circuit giving up to 15 db. boost or cut at either end of the spectrum is shown in Fig. 7. When this circuit is used before the amplifier, the volume control should be R_1 of the equalizer, in order to prevent overload of that circuit.

Fig. 10 shows a professional type equalizer-amplifier for the variable reluctance type pickup. This provides not only more accurate low frequency compensation, but also a slight high frequency roll-off to compensate for recording pre-emphasis.

Because it combines the desirable features of fidelity, simplicity, and economy, this amplifier is unusually attractive to the home builder. With this amplifier in his possession, the high fidelity enthusiast may be confident that he has a sound design that cannot be rendered obsolete by improvements in program material quality. —30—

TV IN BRAZIL

ON July 30 the Tupi television station at Rio de Janeiro, Brazil, transmitted the first of an announced series of four experimental public telecasts.

The show was broadcast from the studio of Radio Tamoio and viewed through receivers placed in the studio of Radio Tupi and at the entrances of the buildings housing the respective stations. The first broadcast was reported to be very successful and was enthusiastically received both by the studio audiences and the large crowds which gathered in the street.

Regular telecasting was scheduled to begin within thirty days of the original program, according to the U. S. Embassy report from Rio. —30—

"It gives better results than my outside antenna!"

NEW TV PRODUCTS on the Market

DEFLECTION YOKE CLAMP

The development of a "Speed Nut" clamp that solves deflection yoke assembly problems for television manufacturers has been announced by *Tinnerman Products, Inc.* of 2036 Fulton Road, Cleveland 13, Ohio.

Adaptable for several different applications, the clamp serves, in some cases, only to mount the yoke to the hood. Where powdered iron cores are used, it also clamps the cores in position. The clamp also provides a solid support for the yoke and picture tube, eliminating the danger of misalignment and broken connections which frequently result from rough handling during shipment.

Specifications and additional data are available from the company.

TV PATTERN GENERATOR

Approved Electronic Instrument Corp. of 142 Liberty Street, New York, New York, is currently marketing the Model A-470 linearity pattern

generator for all types of TV alignment and servicing applications.

This new test instrument permits the adjustment of vertical and horizontal linearity, setting of the hold control, checking for hum in deflection circuits, permits the making of relative sensitivity measurements, and allows troubleshooting without the use of station patterns.

The Model A-470 is housed in a heavy gauge steel cabinet finished in battleship grey. It uses seven standard tubes and a 1N34 crystal. For full details on this linearity pattern generator write the company direct.

17" TV TUBE

The Buffalo and Syracuse plants of the *General Electric Company's* Tube Division have begun production on a 17" rectangular picture tube.

The new tube is the third rectangular type to be made by the company. The others are the 14" and 16" glass models.

Designated the 17BP4-A, the new tube has a neutral-density faceplate and is a magnetic-focus-and-deflection tube. It features an electron gun designed to be used with an external, single-field ion trap magnet for the prevention of ion spot blemish. An

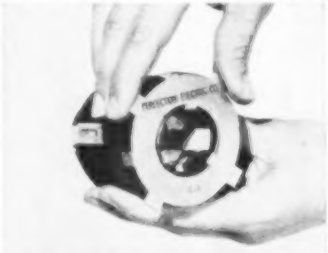
external conductive coating serves as a filter condenser when grounded.

Heater voltage of the 17BP4-A is 6.3 volts and the heater current is .6 ampere plus or minus 10 per-cent. Complete information on the new tube may be secured from the Tube Divisions of the company in Schenectady, N. Y.

CENTERING CONTROL

Perfection Electric Company of 829 South State Street, Chicago 5, Illinois has recently introduced a control for centering television pictures that cuts the time required for that operation to a mere 3 seconds.

Known as the "BeamaJuster," the new unit eliminates the old style mechanical and electrical controls that required numerous brackets, springs, and connections for assembly and took skill and patience to adjust. The control consists of a pair of rotating aluminum plates, one of which holds a permanent magnet. The unit is snapped on the back cover of the TV tube yoke.



It fits any standard yoke and is suitable for any size tube.

The picture is centered by rotating the outer plate with the fingers. Fine adjustments are made by moving the

outer plate up or down or to either side. Once set the picture will not drift, according to the company.

AIR-SPACED FEEDLINE

The new "Goodline Airlead," manufactured and distributed by *Don Good, Inc.*, 1014 Fair Oaks Avenue, South Pasadena, California, has been especially designed to eliminate excessive feedline losses in television and ham installations.

According to the manufacturer, because of the removal of 80% of the loss-producing dielectric web between the wires, the new "Airlead" permits the maximum practical transfer of the signal from the television antenna to the television receiver so that clear and sharp snow-free pictures can be obtained. The 80% removal also allows for the effective utilization of air for insulation and consequently the lowest possible loss is effected.

The feedline comes in five lengths. Samples, new illustrated literature, and complete information are available from the manufacturer.

"SWITCHA-SWEEP"

The *Kay Electric Company*, Maple Avenue, Pine Brook, New Jersey has announced the availability of its "Switcha-Sweep," a new electronic TV sweep generator with fundamental outputs on all channels as well as output in the i.f. range.

A rotary switch selects the desired

channel which is swept through a range of 15 mc. by an all-electronic system. The instrument also produces a zero level reference baseline on the oscilloscope display. Saw-tooth sweep eliminates phasing problems. The amplitude modulation of the sweep signal is less than 1% per megacycle. Both switched and continuously variable output attenuation are provided, with maximum outputs of about .5 volt on the 70 ohm unbalanced output and 1 volt on the 300 ohm balanced output.

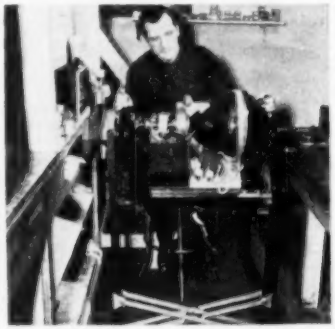
The sweep contains no internal markers and is intended for use with external marker generators. A regulated power supply is provided to allow operation of the instrument under very poor power line conditions.

"ROTO-RAK"

A new television service rack which is said to cut down servicing and alignment time by as much as an hour a day has been introduced by *The Arbor Manufacturing Corporation* of Depew, New York, as the "Roto-Rak."

Designed to handle any size or make of TV chassis, the service technician merely fastens the two chassis bars to the bottom of the chassis, sets up the frame by spreading it apart, and mounts the chassis bars on the cross-arms.

All parts are easily reached by turning the entire assembly, which can



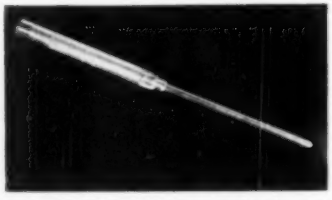
then be locked in any convenient position. The rack can be set up next to the test bench and since it is equipped with casters it may be moved about while the set is mounted. The unit may also be adapted for use in automatic record changer repair.

TV ALIGNMENT TOOL

Spot Tools, Inc. of Morris Plains, New Jersey has recently begun marketing a new illuminated television alignment tool.

The new unit has a sturdy aluminum barrel containing two batteries, a bulb, reflector, and a shock-resistant spring which protects the bulb should the tool be dropped. The handle is water-resistant.

The lucite tip, which is set in tenite, will accommodate alignment tips of two diameters. The tool comes



equipped with one tip. As the tips are interchangeable and the light spots the working area, the new unit is a time-saver for the TV technician.

NEW "VOLTOHMYST"

A radically new *RCA* "Senior Volt-Ohmyst," the first electronic service-type voltmeter providing direct peak-to-peak measurement of complex wave shapes up to 1400 volts, has been announced by the Test and Measuring Equipment Section of the *RCA* Tube Department, Harrison, New Jersey.

Especially designed for television signal tracing and industrial servicing, the new Model WV-97A contains a full-wave, high-impedance, high-fre-

quency signal rectifier circuit featuring wide frequency response and high voltage ratings.

In addition to peak-to-peak measurements, the instrument reads d.c.

voltages, resistance values, and r.m.s. values of sine waves. The direct-reading peak-to-peak scales permit the technician to measure sync pulses, composite waveforms, and deflection voltages in TV receivers without time-consuming computations.

The instrument also provides seven d.c. ranges, seven a.c. r.m.s. ranges, seven peak-to-peak ranges, and seven ohm ranges, all continuous in ratio steps of about three-to-one without skip ranges.

Full details on the "Senior Volt-Ohmyst" are available from *RCA* distributors.

TV BOOSTER

A television booster which operates automatically without tuning has been announced by *Blonder-Tongue Laboratories* of 20 Gunther Avenue, Yonkers, N. Y.

The new booster, called the "B-T Antensifier," utilizes an original, patented wideband amplifier principle which allows simultaneous amplification of the high and low television bands, as well as sound, without adjustment. An automatic power switch is controlled by the TV receiver's "on-off" knob, yet requires no internal connection to the TV chassis.

The unit incorporates a new amplifier which offers a high average gain

of 20 db. over the entire TV frequency range. Four v.h.f. duo-triodes are used in a high efficiency circuit to provide a good signal-to-noise ratio and interference rejection.

The booster is housed in a compact cabinet finished in alligator grain and measuring 7½ x 5¾ x 4¼".

WARD'S YAGI

The *Ward Products Corp.* of Cleveland, Ohio has added a TV antenna to its line, the new Yagi.

Based on the interlinking folded dipole principle, this model is said to be different from other antennas. Designed to provide good performance in fringe areas of weak signal strength, a built-in impedance transformer steps up impedance. Its narrow beamwidth permits maximum energy pickup, and pinpoint directivity with a very high front-to-back ratio eliminates co-channel interference, according to the company.

There is a separate model for each TV channel. The antenna is constructed with "Perma-Tube" cross arms for maximum horizontal torsional strength. Mast brackets take up to 1⅝" masts. Stacking kits for stacking either high or low band arrays are also available. The units are factory preassembled, ready to unfold and install.

PORTABLE TV "LABORATORY"

Oak Ridge Products of 239 East 127 Street, New York 35, New York, has developed a miniature composite test

"laboratory" for the servicing of FM and television receivers.

The unit includes the company's Models 101 substitution tester, 102 high voltage meter, 103 signal generator, and 104 synchro-sweep generator all in a single carrying case.

The new instrument case is available in two models, the X-100 which has all four units permanently attached inside the carrying case, and the A-100 in which the four units have individual cabinets housed in a larger carrying case.

AMPLIFIER TUBE

A new double-ended beam power amplifier tube, designed for use as the horizontal deflection amplifier in television receivers, has just been announced by the Tube Divisions of *General Electric Company*, Syracuse, New York.

When used with suitable components, the new tube (6CD6-G) is capable of fully deflecting any picture tube having a deflection angle up to 70

degrees and operating at anode voltages up to 14 kilovolts.

The 6CD6-G is rated with a peak positive pulse plate voltage of 6000 volts; maximum d.c. plate voltage of

700 volts; plate dissipation, 15 watts maximum; d.c. plate current, 170 ma. maximum.

Complete data on the new tube may be obtained from the company.

WAND ANTENNAS

Peerless Products Industries, Inc. of 812 North Pulaski Road, Chicago 51, Illinois has introduced two new low cost indoor antennas, the "Golden Wand" units.

Both models, which cover the TV and FM bands, have dipoles made of highly polished Admiralty brass which will not rust or corrode; easy, jamless telescopic action; automatic friction allowing adjustment of the dipoles at any angle without slipping; and phosphor bronze contacts for best electrical conduction.

The Model GS4TV has a tarnish-free and rustproof round base in gold satin finish with a plastic knob for dipole adjustment. The Model 50TV has a heavily weighted base of molded polystyrene in highly polished mahogany-walnut finish.

Catalogues and price information on either or both of these antennas are available from the manufacturer.

NOVEL ANTENNA

The Radion Corporation of 1137 N. Milwaukee Avenue, Chicago 22, Illinois, has introduced a novel indoor

television antenna, the Model TA55 "Foto-Tenna."

To the casual observer the new antenna appears to be an ordinary leatherette photograph album. Actually

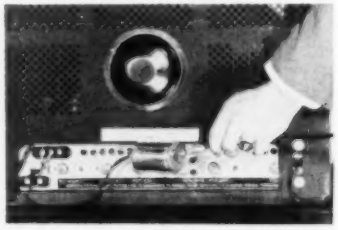
the folder conceals an effective indoor antenna which is said to provide reception in most metropolitan locations.

The new antenna comes complete with 10 feet of 300 ohm lead-in. The company will provide full details on request.

MATCHING TRANSFORMER

The Brach Manufacturing Corporation of 200 Central Avenue, Newark, New Jersey, has developed a new 75 to 300 ohm matching transformer with high pass filter action.

The new unit, which has been designated the No. 72-300, is designed to be a perfect termination at Channels 2-13 but offers a serious mismatch to



diathermy and short-wave interference transmissions in the i.f. band. A coaxial fitting is furnished with the transformer to make a low-loss connection to RG-59/U. The transformer has negligible loss over the complete TV band and a voltage gain of two-to-one.

TV FUSE KIT

Littelfuse Inc. of 4757 Ravenswood Avenue, Chicago 40, Illinois, is currently marketing a handy fuse kit for television service technicians.

The kit, which measures only 2¼" by 1½", contains 10 fuses in eight of the most-often-needed types. Two of the eight are duplicated, giving more adequate coverage on the more popular types.

Additional details on this new fuse assortment are available from the company.

ADJUSTABLE TV TABLE

The *Abner-Hull Manufacturing Company* of 143 Newbury Street, Boston, Massachusetts is presently marketing an adjustable television table which can be used with virtually any make or model table TV receiver.

The table is made from kiln dried Northern hard woods and finished in "deep color" brown mahogany. Models finished in blonde wood are also available. The table is designed with reversible panels to provide high or low edges depending on the requirements of the television set. The legs are equipped with glides and an adjustment for non-rocking.

This table is adjustable from 16¾" x 16¾" to 26½" x 26½". The adjustment feature is completely concealed and the size adjustment can be made in less than a minute without the use of tools. —30—

USED Correspondence Courses and Educational Books bought, sold, rented. catalog free. Educational Exchange, Summerville, Ga.

WANTED

SNIPERSCOPE & Snooperscopes wanted. Any type, any condition. Needed immediately. Box 495, % Radio & Television News, 185 N. Wabash Ave., Chicago 1, Ill.

WANTED: APR-4 receiver and tuning units. State condition and price. W2DB, 274 Boulevard, Scarsdale, N. Y.

AN/APR-4, APR-5A Receivers and Tuning Units, laboratory quality Test Equipment, dial telephones, stepping switches, Motorola program-clocks and tuners, surplus stocks. ARR-5, ART-13, etc. Describe and price in first letter. Chas. Littell, Fairhills Box 26, Dayton 9, Ohio.

PATENT ATTORNEYS

HERMAN Lewis Gordon, Registered Patent Attorney. Patent Investigations and Opinions. Warner Building, Washington, D. C.

LANCASTER Allwine & Rommel Registered Patent Attorneys. Patent practice before U.S. Patent office. Validity and Infringement investigations and opinions. Booklet and form "Evidence of Conception" forwarded upon request. Suite 414, 815 15th St., N.W. Washington 5, D.C.

MISCELLANEOUS

15 TESTED One-Tube circuits 25c, including "Radiobuilder," catalog. Laboratories, 578-H, San Carlos, Calif.

ELECTRONIC Research. Equipment designed or built to specifications. Inventors, experimenters, inquiries invited. E. A. K. Research Laboratory, Box 62, Tarrytown, N. Y.

ELECTRONIC Equipment constructed to your ideas, specifications, articles. Write: Radio Sound Co., 64 Gold St., New York City.

YOUR name & address on 1000 gummed labels $2.00 postpaid. Colorful House Butte, 551 5th Ave., New York City. (Rm. 2201)

SPECIALIZED SWL's, QSL's! Samples! Printers, 2705 S. 7th, Council Bluffs 5, Iowa.

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WINNER PICKS PRIZE

David Kusner, second prize winner in the National Science Fair, selected a new RCA Senior VoltOhmyst as his award.

Presented recently by J. B. Coleman, Asst. Director of Engineering for RCA, the prize was won by Kusner for his exhibit of an elaborate, automatic r.f. heating unit. —30—

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134 (top)	Lauretsen Marquee Radio
134 (bottom)	Radio Turkey

ERRATUM

In the article "New Applications for Crystal Diodes" appearing in the June 1950 issue, further checking has shown that the low voltage regulator shown in Fig. 5 will not operate as described.

Due to a faulty setup with a voltage source of poor regulation, erroneous readings were obtained which indicated that voltage regulation was being obtained. Further checking by the author under conditions more closely controlled, showed that the apparent regulation was due to a faulty voltage source. We regret any inconvenience this error may have caused our readers.

INDEX OF Advertisers

OCT. 1950

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

TV Servicing with GDO
(*Continued from page 65*)

sensitivity as the front end is approached.

Only after the horizontal circuit is functioning properly should the grid dip oscillator be used to check the vertical pattern. Some service technicians feed a signal generator, set for 150 to 200 kc. output, into the video amplifier, to give a number of vertical lines. But, with a grid dip oscillator it is necessary to have the front end gain so that the instrument needs no direct connections to the set.

To obtain and hold a horizontal pattern, the grid dip oscillator frequency is tuned to the channel frequency and then carefully tuned off this frequency until a pattern of vertical lines is noted. Final tuning must be done by the set control with the contrast and brightness adjusted to their optimum settings. At this point it is advisable to check horizontal linearity with other vertical circuit functions.

As in all good television alignment procedures, each channel should be checked from the front end. Using the horizontal bars or a local station if possible, align each channel to its proper frequency. It is the usual practice to tune the local stations in with the contrast set at "gray," adjust for brightness for a fine definition, clear the "gray" picture, and then bring up the contrast to the desired level. The resultant picture is one that shows up the results of a good alignment job. When the grid dip oscillator is used properly it provides a new approach to television servicing which promises faster, easier servicing which is more along the line of the old-time radio servicing techniques.

—30—

NEW TELEVISION STATIONS

TWO Vancouver radio stations, CKWX and CKNW, have recently made formal application to the Canadian Broadcasting Corporation for permission to enter the television field, according to word released by the U. S. Department of Commerce.

Famous Players (Paramount) has also expressed interest in a Vancouver video outlet. The CBC Board of Governors favors a joint application from Vancouver commercial groups which would share costs. Such a group, it is understood, would be able to expect some financial aid from the CBC. Thus far, no joint applications have been made.

There are at present about 150 TV receivers in the Vancouver area. Excellent reception from Seattle is reported. Approximately 600,000 persons, living within 60 miles of Vancouver, would form the potential television audience.

Montreal and Toronto are the only TV stations authorized by Canadian broadcasting officialdom thus far, but both Vancouver and Ottawa hope to get studios before 1952.

—30—

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HiV Under 500mmf/15KV ..... .79
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RCA HiV Defl Xfmr 211T1 ..... 4.98
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0-150 Volts AC, 2½" Weights Coil ..... .98
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Input	Output	Amps	Each
18V	24V	1	$2.49
30V	24V	1	1.49

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18V	14V	0.4	5.45
18V	14V	6	6.95
18V	14V	12	8.95
115V	75VC	11.5	11.95
30V	28V	3.5	6.49
30V	28V	5	8.49
30V	28V	0.15	1.49
230V	115V	3.5	18.49

CIRCUIT BREAKERS

Heinemann Magn Brkrs Amps in .22, .3, .6, .12, .20, .25, .30, Ea. $1.49
Klixon Thermal Push Button Reset Amps .5 to 15, Ea. 79c
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A. Postage Meas: .003/.00 mfd ..... 12 for 98c
B. Lug Terms: .00Smfd/.00Wv:

Type	Mfd	Wv	Each
A	.006	600	9.25
B	.008	600	.25
B	.01	600	.45
A	.02	600	.98
B	.002	1200	.30
B	.01	1200	.50
A	.0004	2500	.35
A	.005	2500	.75
A	.01	2500	1.30

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Mfd	Volts	Each
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.00005	3000	.65
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2 mfd	21c	1 mfd	26c
		2 mfd	49c
600 WVDC			
1 mfd	27c	3 mfd	35c
2 mfd	39c	2x.25 mfd	29c
4 mfd	67c	3x.25 mfd	39c
6 mfd	89c	4x.25 mfd	49c
2x.1 mfd	23c	**1000 WVDC**	
3x4 mfd	33c	1 mfd	45c
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Mtd FT243 exacting .5% spec

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3	320	1495	3730 18000 130000
3.83	325	1500	3760 18300 135000
4	330	1510	4000 18380 140000
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17	452	1896	5270 24600 201000
19	460	1897	5300 25000 205000
19.2	470	1898	5500 25200 215000
20	475	1899	5600 25400 215000
22	478	1900	5730 25833 220000
23	480	1901	5770 26000 225000
24	487	1902	5910 26500 225000
25	500	1903	5000 26600 230000
26	520	1904	6100 27000 235500
28	525	1905	6125 27500 238000
30	540	1906	6140 28000 240000
31.5	550	1907	6200 28430 245000
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48	580	1909	6495 29000 265000
49	586	1910	6500 29500 280000
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60	640	1915	7500 32000 307500
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68	645	1917	7717 35000 314000
74	649	1918	7900 37500 315000
75	650	1919	7910 38140 325000
80	657	1922	7950 38500 330000
81.4	665	1924	8000 39000 333500
88	666	1926	8094 39500 350000
89.8	670	1960	8250 40000 351500
95	673	1980	8500 42000 375000
100	675	2000	8700 43000 380000
101	680	2045	8770 45000 400000
105	681	2080	9000 47000 402000
105.7	684	2095	9100 47500 420000
107	689	2141	9445 48000 422000
120	697	2142	9560 48660 425000
121.2	699	2145	9710 49000 450000
125	700	2150	9800 50000 458000
130	711	2160	10000 52000 475000
135	733	2180	9902 55000 500000
147.5	740	2187	10000 56000 520000
150	750	2195	10430 57065 521000
160	800	2200	10500 58131 522000
165	806	2250	10600 60000 543000
170	850	2300	10900 61430 550000
175	854	2400	10936 62000 570000
179	899	2450	11000 64000 575000
182	900	2463	11400 65000 600000
182.4	910	2485	11530 66600 620000
200	917	2490	11900 69000 650000
209.4	946	2500	12000 75000 654000
216	978	2525	12500 78000 660000
220	1000	2600	12800 70000 690000
220.4	1030	2625	13000 72000 725000
225	1056	2635	13100 73500 750000
230	1059	2700	13500 75000 761300
235	1067	2750	13550 80000 800000
240	1100	2850	13800 82000 810000
245	1110	2860	14000 84000 850000
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1.39	2	3	4.5	7.62	11
1.4	2.11	3.1	5	7.74	12.83
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					13.85

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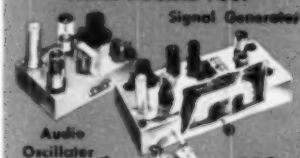
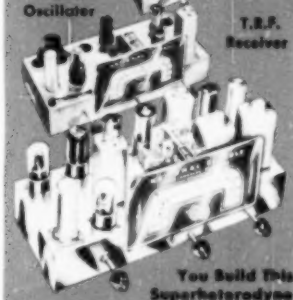


Signal Generator

Audio Oscillator

T.R.F. Receiver



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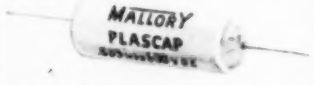

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